Popular Science Monthly

239 Fourth Ave., New York

Vol. 89
No. 4

October, 1916

$1.50
Annually

Wild Animals That Photograph Themselves

PHOTOGRAPHING by flashlight is one of the more recent advancements in the field of picture-taking which has helped to secure for photography a permanent place among the arts. Paul J. Rainey, the explorer and hunter of wild animals, proved several years ago at the first exhibition of his wild animal flashlight pictures taken in Africa, that this class of photography offered a virgin field to the manufacturer of apparatus and to the man behind the camera. Soon after this there was an awakened interest in animal film shooting in preference to gun or trapshooting.

At the present time photographic flashlight apparatus has been developed to a point where guesswork is eliminated and where it is possible to photograph any object in motion. To do this it is necessary for the camera to catch the object in motion just at the instant when the flash powder is giving forth its brightest light. This requirement calls for a high-speed shutter to stop the motion on the plate of the object being photographed. With a flashlamp recently perfected by William Nesbit the shutter is automatically snapped at exactly the moment when the light from the flash powder is most intense. His apparatus has been widely used to take flashlights of wild animals in their native haunts and has given uniformly good results.

When flash powder is ignited it does not burn up or explode instantly, as might be supposed. It burns more and more brightly until it reaches its point of greatest brightness, from which point on it dies down until it goes out. This whole operation takes at the most one fifth of a second. However, good pictures will be obtained only if the camera is snapped during this fifth of a second, when the flash powder burns the brightest.

On the other hand, this point can never be definitely determined before taking the picture. It changes for different powders and also varies for the same powder, since the powder may become slightly damp and will not burn in the same way. It is evident, then, that to snap the camera at precisely the right moment is not so easy as it might appear.

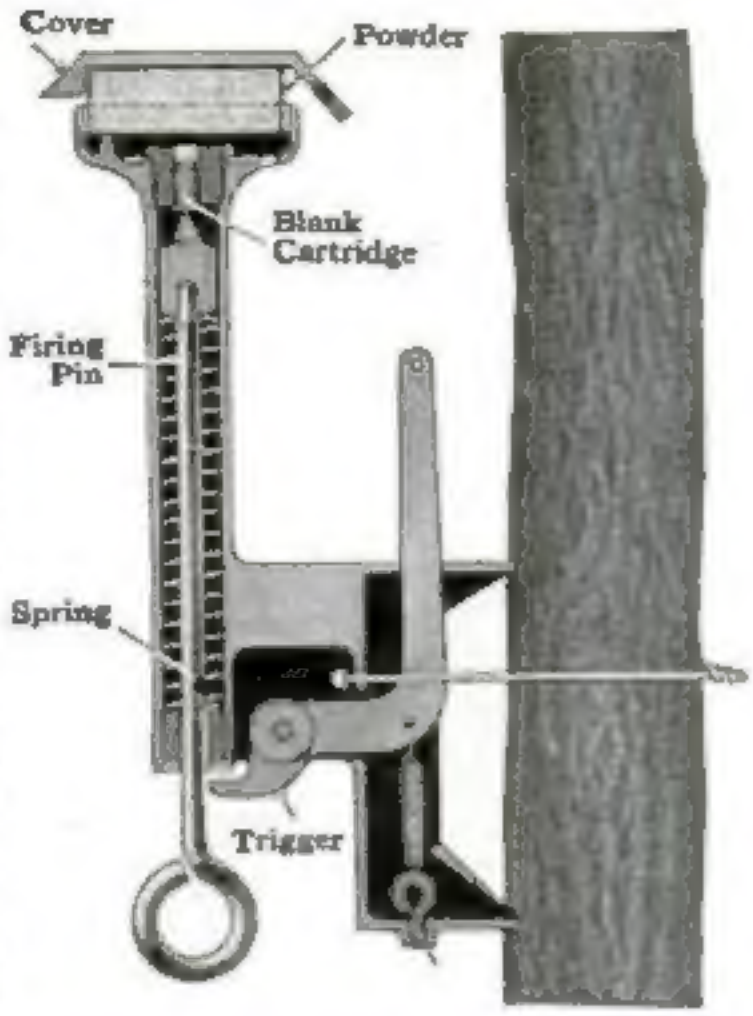
The flashlamp devised by Mr. Nesbit consists of an aluminum container to hold the flash powder, a cover for this container, a mechanism to fire the powder, and an attachment which will automatically snap the shutter of the camera at the moment when the flash powder is burning brightest. The unit is waterproof, and so compact that it can be readily attached to a tree or other convenient support.

The flash powder is placed in a box made waterproof by a coat of paraffin and is then placed in the space provided for it in the flashlamp. The powder is fired either by a blank cartridge or by an electric spark furnished by a dry battery. A firing-pin, controlled by a spring and a trigger, similar to those used in a rifle or revolver, sets off the cartridge.

When taking a flashlight of an animal, a wire is attached to the trigger and then tied to bait of some sort. The animal is attracted by the bait, and if it touches it, the wire is pulled, which, in turn,

pulls the trigger, releases the firing-pin and ignites the powder by exploding the blank cartridge. When the powder is to be ignited electrically, a wire is stretched from a switch to the bait. Once the bait is touched a circuit is closed and an electric spark sets off the powder.

The shutter on the camera designed by Mr. Nesbit is operated by means of the cover placed over the container holding the powder. This cover is attached to a chain



be found. The cover is so arranged that it cannot be blown off until the powder is burning with its greatest brightness.

When the wire to the bait is pulled, the powder is ignited and commences to burn. For a small fraction of a second the cover remains in place while the powder burns. Then, when the powder is burning with greatest vigor and is giving off its brightest light, the cover is blown off and the shutter of the camera is snapped.

The wiring arrangement, showing the flash occurring at the very instant the bait is touched by the animal

Below, the animal attracted to the bait, which is attached to a trigger which releases the firing-pin

which is fastened to a tree or post supporting the lamp. This is to prevent the explosion of the powder from blowing the cover so far away that it cannot

Sometimes two sets of cameras and flash-lamps are used to give two pictures of the same animal in different positions, before and after his fright.

Instead of closing its doors or moving while its building was being enlarged, this bank staid where it was and had a new structure built around the old without the least interruption

Building a Bank Around a Bank Without Disturbing Business

A DETROIT bank recently found that so much money was coming in that there was not enough room to store it. Instead of closing the doors and shutting off this desirable influx of dollars, the bankers decided to build a new home for their dollars outside of the old one.

Accordingly, banking hours remained the same. As the old building was torn down, part by part, new offices were opened in the growing outer structure. There was no interruption. The new building has three times the capacity of the old one.

Steel Cutlery Which Will Not Rust Under Any Circumstances

THE housewife can now cease to worry about tarnished or rusted knives, forks, etc. A new steel has appeared from which cutlery is being made which not only takes a beautiful polish but which preserves this appearance under all circumstances. It neither rusts nor tarnishes in contact with foods or acids and its use is making great headway. To be able to use a knife or fork and to have it maintain its original brightness by simply washing it is a boon to the housekeeper.

The new steel composition was invented in England and is what is commonly known as an alloy steel. It is not a high carbon steel for it averages only 0.25 to 0.35 per cent carbon but the ingredient which bestows on it its unusual properties is chromium, a chemical element or metal similar to nickel. By incorporating from 12 to 13 per cent chromium in mild carbon steel, the new stainless properties are bestowed upon the manufactured product.

The new steel is more expensive than that formerly used in making steel cutlery but its lasting properties as well as its appearance and convenience more than offset this extra cost. Its possibilities are not limited to cutlery.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of The Popular Science Monthly is willing to answer questions.

A Mechanical Masseur That Works Off Fat and Soothes the Nerves

"VANITY of vanities—all is vanity," saith the preacher; but the desire for a svelte figure may not be altogether vain. Excessive weight may mean faulty elimination of waste and underweight may mean nervous tension, so that both are to be avoided. It should be a source of satisfaction to discover a means of acquiring a fine, symmetrical form and physical fitness at the same time without entailing loss of time or any long-drawn-out course of exercising.

The automatic massaging machine illustrated here has been designed with that end in view. It is scientific in principle and is composed of a double circle or belt of forty-eight roller-wheels hung on oscillating frames four inches apart. This belt encircles the body, the upper left-hand roller in each frame overlapping the lower right-hand roller in the next frame, so that as the frame expands in passing from the smaller to the larger portions of the body the rollers still pass over the entire surface of the skin.

An elastic belt between the two rows of rollers gives equal pressure to each roller, regardless of what position the frame takes in traveling over the irregular surfaces of the body. Thus the hollows receive the same pressure and stimulation of circulation as the higher portions. This pressure can be increased, diminished or shut off instantly simply by pushing a button. The rollers can be set to travel from the knees to the neck or the stroke can be shortened to any length and massage applied exclusively to any part desired.

The machine weighs two hundred and thirty-five pounds and is equipped with a one-sixth-horsepower motor for any current. A substantial iron base is provided which eliminates vibration when the machine is in action.

Forty-eight roller-wheels hung on oscillating frames travel over the body from the knees to the neck and the pressure can be increased at will

Taking a Census of Occupational Diseases

A STUDY of the subject of occupational diseases affords abundant surprises. House-maid's knee, for instance, which for many years has served as a subject for humorous comment, proves to be a frequent malady of miners. Dust has been found to contain not only minute particles but a watery envelope surrounding the particles. Sawing certain kinds of woods is said to produce irritation of the mucous membranes of the nose, throat and eyes. Chimney-sweeps are especially subject to cancer because soot gets into the system.

Transporting the Wounded Man in Comfort

Photos © Int. Film Serv.

Above, an aerial cableway for the transportation of wounded soldiers in the Alps. The wounded man on his stretcher is placed on the cableway-car and transported to the hospital base above or below him

Above, a basket arrangement of seats, one on each side of the horse, accommodates two wounded soldiers

A dog ambulance with inflated tires and light springs which insures a comfortable ride

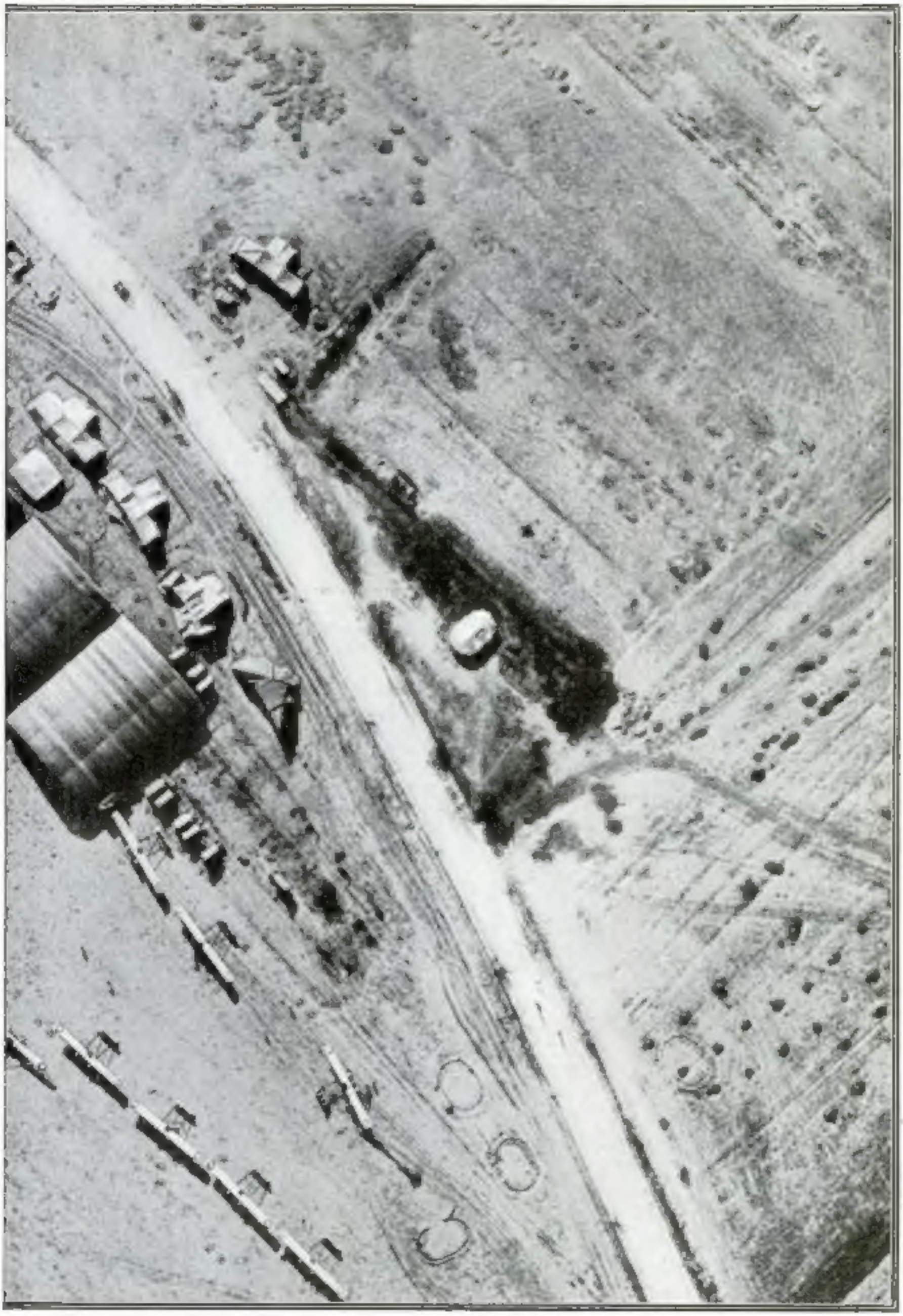
Press Illustrating Serv.

Bird's-Eye View of an Aviation Camp Near the

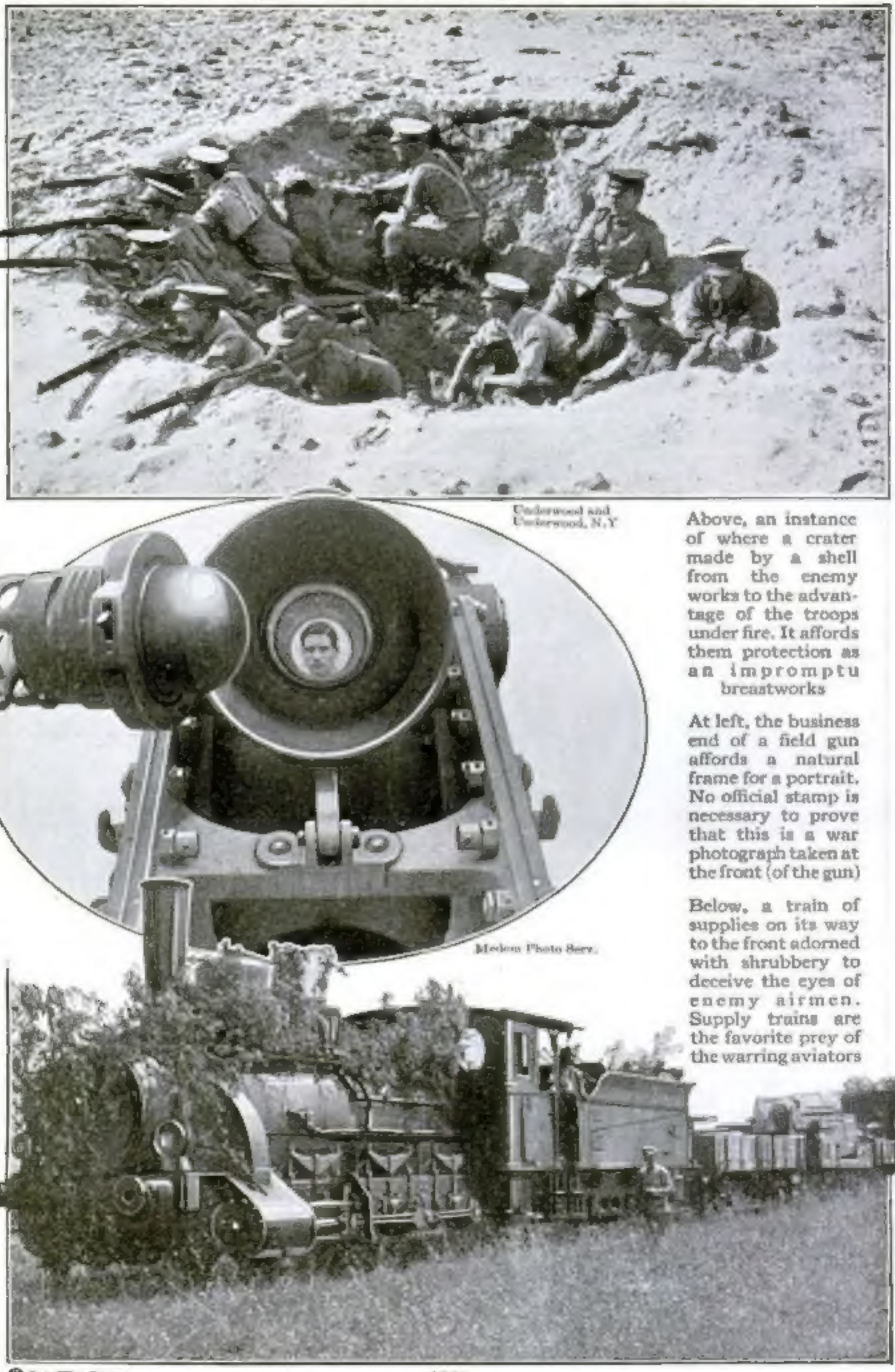
© Underwood and Underwood, N. Y.

A remarkable photograph of a French aviation camp near Verdun. The picture was taken by a French aviator at an elevation of 1800 feet directly over the camp. The huge tent-like structures are aeroplane hangars and in front of them are stretched eighteen flying ma-

Great Battlefield of Verdun Made from an Aeroplane



chines. Grouped about the hangars are motor-trucks and cars. To the left are the tents which constitute the homes of the aviators, pilots and others stationed at the camp. The white streak diagonally across the photograph is a road. To the right are farm lands



Underwood and Underwood, N.Y.

Above, an instance of where a crater made by a shell from the enemy works to the advantage of the troops under fire. It affords them protection as an impromptu breastworks

At left, the business end of a field gun affords a natural frame for a portrait. No official stamp is necessary to prove that this is a war photograph taken at the front (of the gun)

Below, a train of supplies on its way to the front adorned with shrubbery to deceive the eyes of enemy airmen. Supply trains are the favorite prey of the warring aviators

Modern Photo Serv.

Sowing Fifteen-Inch Seeds with the Big Guns

Medem Photo Serv.

Armored trains moving on the enemy in the Vosges. The guns are mounted on turntables which enable them to operate over a circumference of one hundred and eighty degrees

At right, a hole made by a German aerial torpedo in territory held by the British on the western front. Nothing, human or otherwise, can withstand these immense torpedoes

© Int. Film Serv.

An English monster mounted on a railroad truck on its way to the Somme district to pulverize concrete trenches and batter back the invading enemy

© Central News Photo Serv.

Ammunition to Blaze the Way at Verdun

© Medem Photo Serv.

A collection of different-caliber shells which gives a vivid illustration of the variety of ammunition used in modern warfare. Each shell is specifically designed for a certain purpose, even though they are all meant for man-killing. The little fellows pick out a single man for their target; the big ones choose a whole company, fort or locality for theirs

Below, a depot of big-caliber shells which have helped in their way to make Verdun a five month's nightmare. These shells are stored in the rear of the fighting lines and are taken to the front as they are needed. Powerful motor-trucks distribute them to the armies

© Universal Press Syndicate

The Stuff That Modern Victories Are Made Of

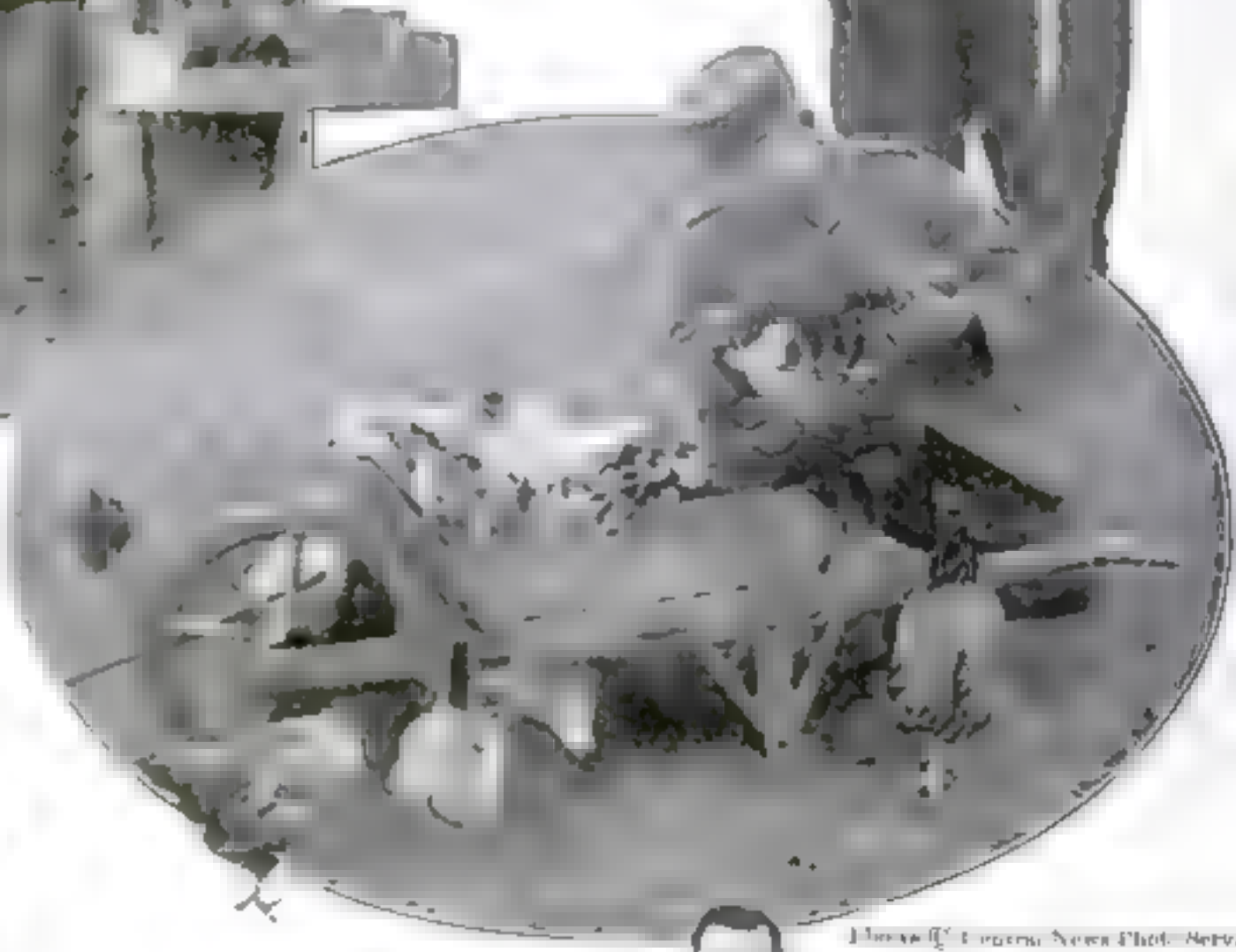
Above a heap of trench mortar ammunition behind the lines of the British troops on the western front. These rounds blow the shells are fired from trench guns into the trenches of the enemy, where they explode with terrific force. Below, shells stacked for convoying ready for transporting

A French trench with a barbed wire fence protecting it from intruders. A door leads through the wire barricade and beside it stands a sentry, ready to interrogate everyone who approaches

Pets and the Gentler Side of the Fighter

At left, a fawn left by its frightened mother in the friendly hands of German soldiers. This little animal was adopted as the troop company's mascot and given a home in the trenches, where it was sheltered from shots and shells

At right, a British soldier with a little king of the beasts as his pet. Will it be a bodyguard such as that of St. Geronimus?



At right: Raising chickens while the enemy is raising siege guns for action is rather soothing for the fighting man, besides the luxury of the fresh eggs for breakfast

At left, the dog they left behind makes his home with the soldiers, and gets better treatment than he would if there had been no war

At right, rabbits are as friendly as they are prolific. They are perfectly at home in the trenches

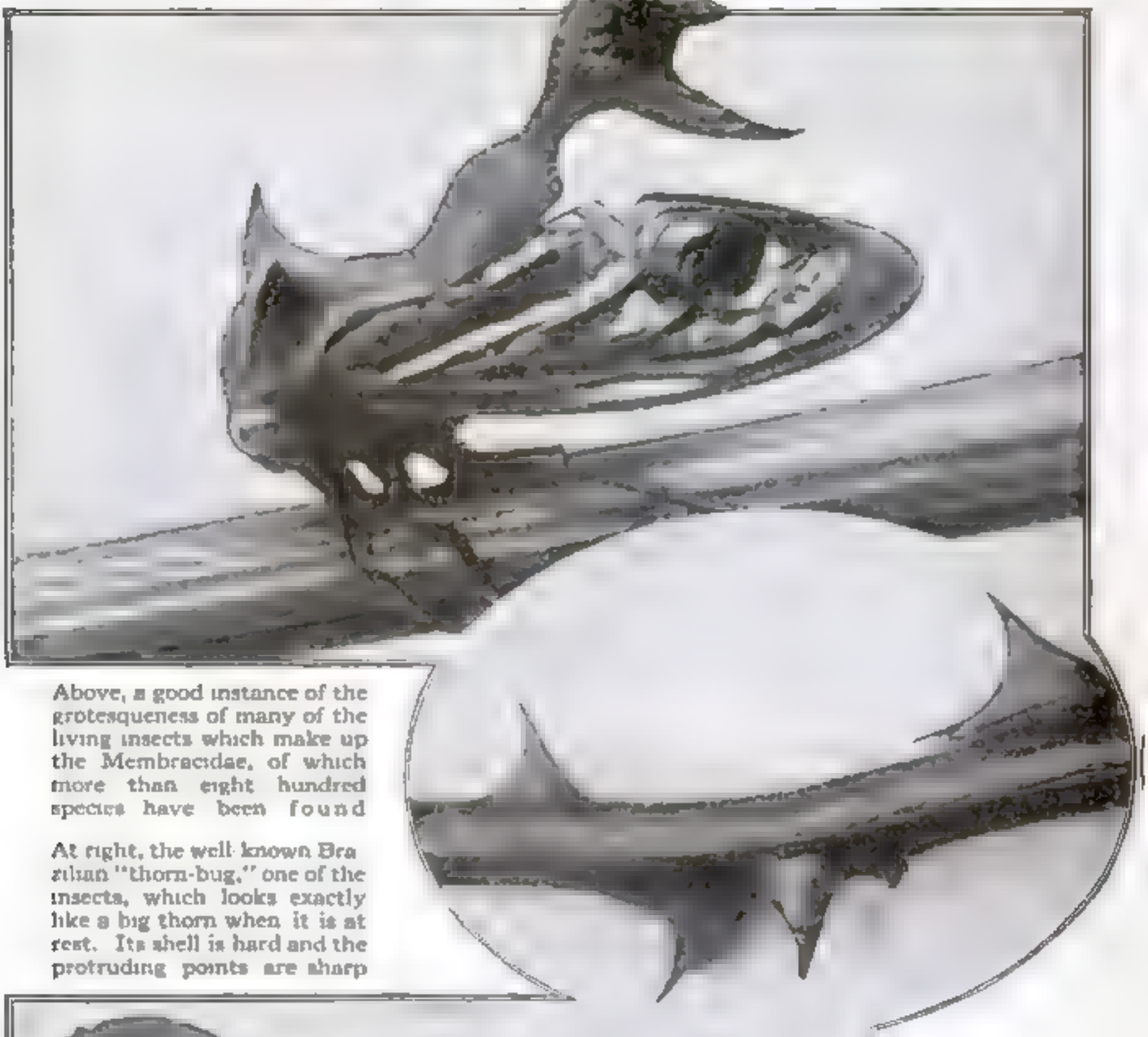
Restoring the Hearing of Deafened French Soldiers

Dr. Marage, a well known French physician, has been asked by the French Minister of War to treat soldiers who have been deafened by the explosions of shells and grenades. To the right, Dr. Marage is shown examining a soldier to determine the extent of his injuries, the first step toward the restoration of his hearing

As shown at the left, Dr Marage treats deaf soldiers by making them listen to the sounds uttered by a vowel-pronouncing machine of his own invention The vowels are uttered with an intensity, duration and quality determined by the bag of compressed air in the foreground

Below, Dr. Marage's apparatus for treating deafened soldiers. It is a mechanical mouth for uttering vowel sounds. The inner ear is massaged by sound vibrations for about two weeks. No less than sixty-eight per cent of the soldiers treated are able to rejoin their regiments

Insect Grotesques Which Assume Frightful



Above, a good instance of the grotesqueness of many of the living insects which make up the Membracidae, of which more than eight hundred species have been found

At right, the well-known Brazilian "thorn-bug," one of the insects, which looks exactly like a big thorn when it is at rest. Its shell is hard and the protruding points are sharp

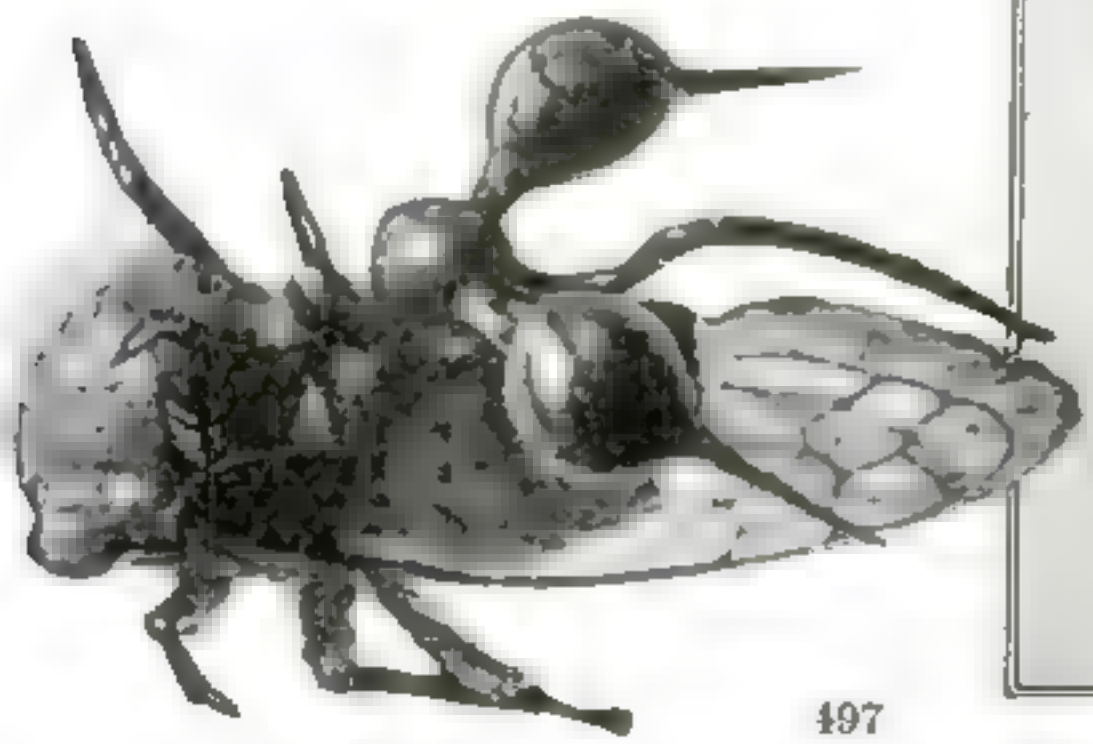
Another quaint Membracid. The use, if any, of the strange extension of the prothorax is unknown. It is part of the "back-plate" that Nature has worked upon to produce the varied and wonderful forms for which these insects are so remarkable

Above, a number of seed-like Membracidae from tropical South America. They are probably overlooked by all but the most astute insect eating birds in search of a meal

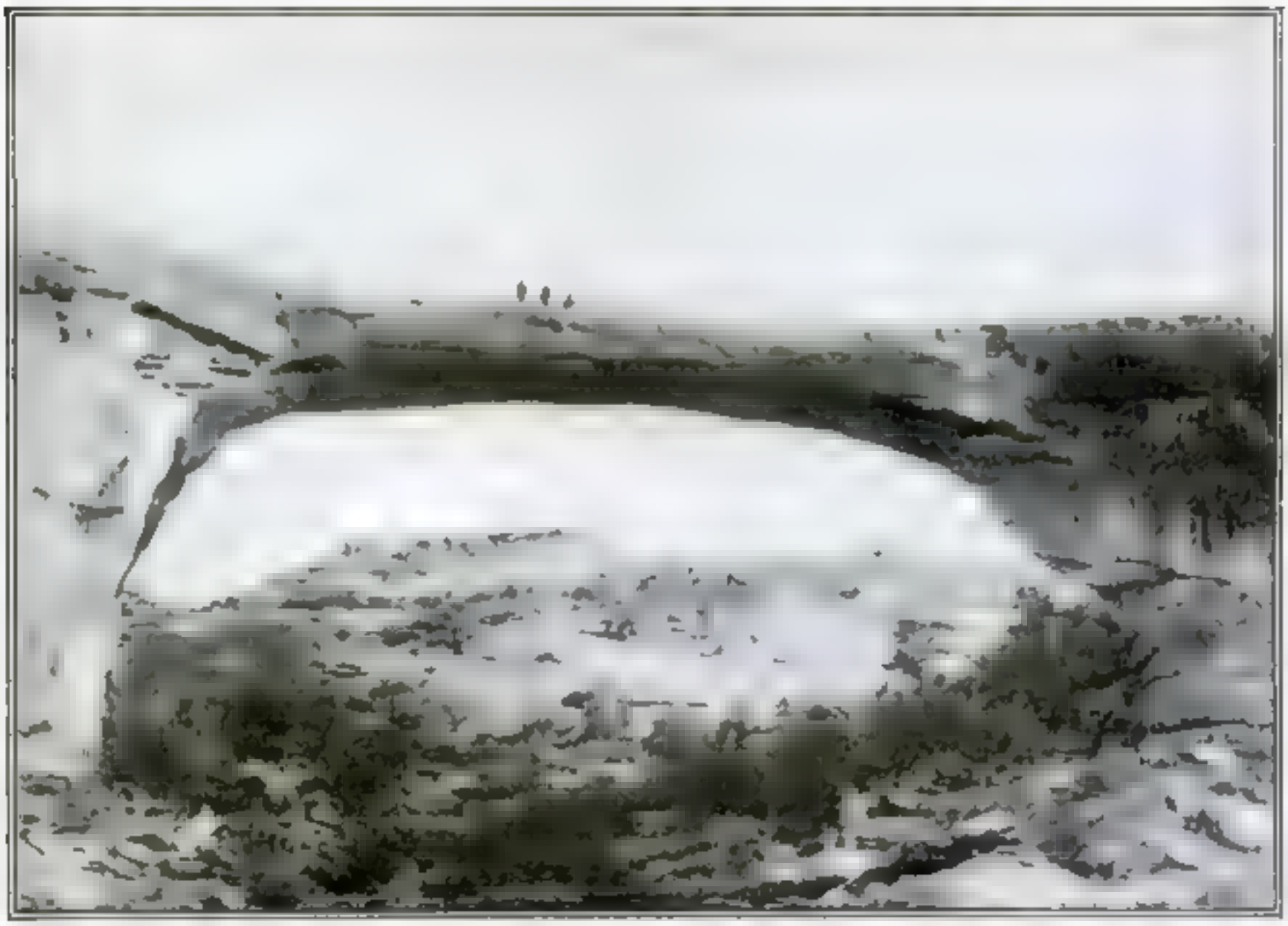
At left, an extraordinary insect with a huge, helmet-like expansion of the prothorax. This is so large in some insects that they are completely covered by it

Below, a strange looking insect which, when alive, looks as if it were being attacked by a spider. This is really the insect's armor plate

At right: The apparent body and formidable sting of this insect are a mere pretense, being only a horny outgrowth from the thorax

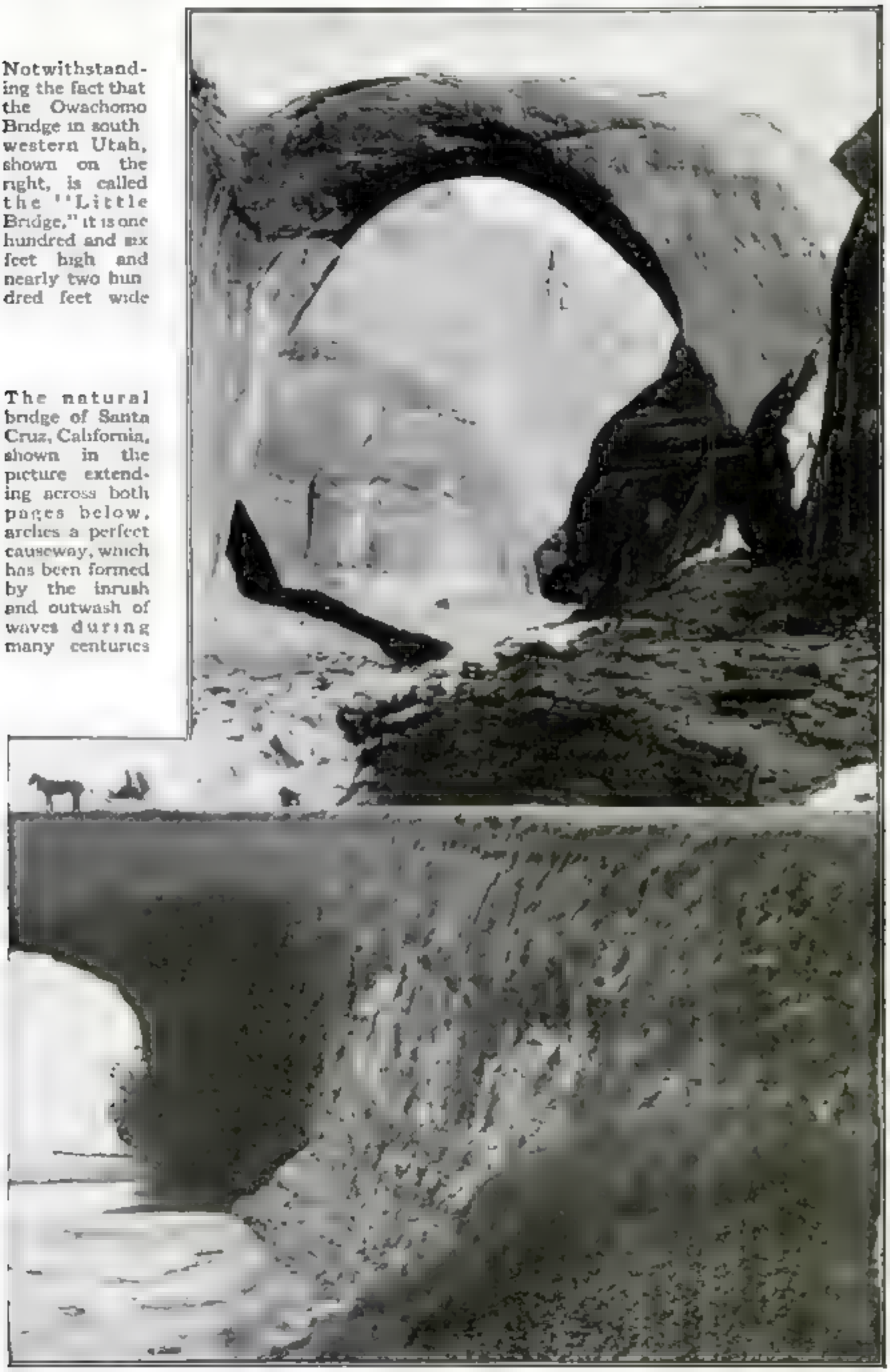


When Nature Plays the Architect of Bridges



The Nonnezoshe, or Rainbow arch, shown above, has been carved by the elements from the brick-red sandstone of southeastern Utah The Navajo Indians called it the Sun-Path and beneath it are ruins of an ancient altar doubtless built by superstitious cliff dwellers

Her Tools Are the Elements and World-Old Rock



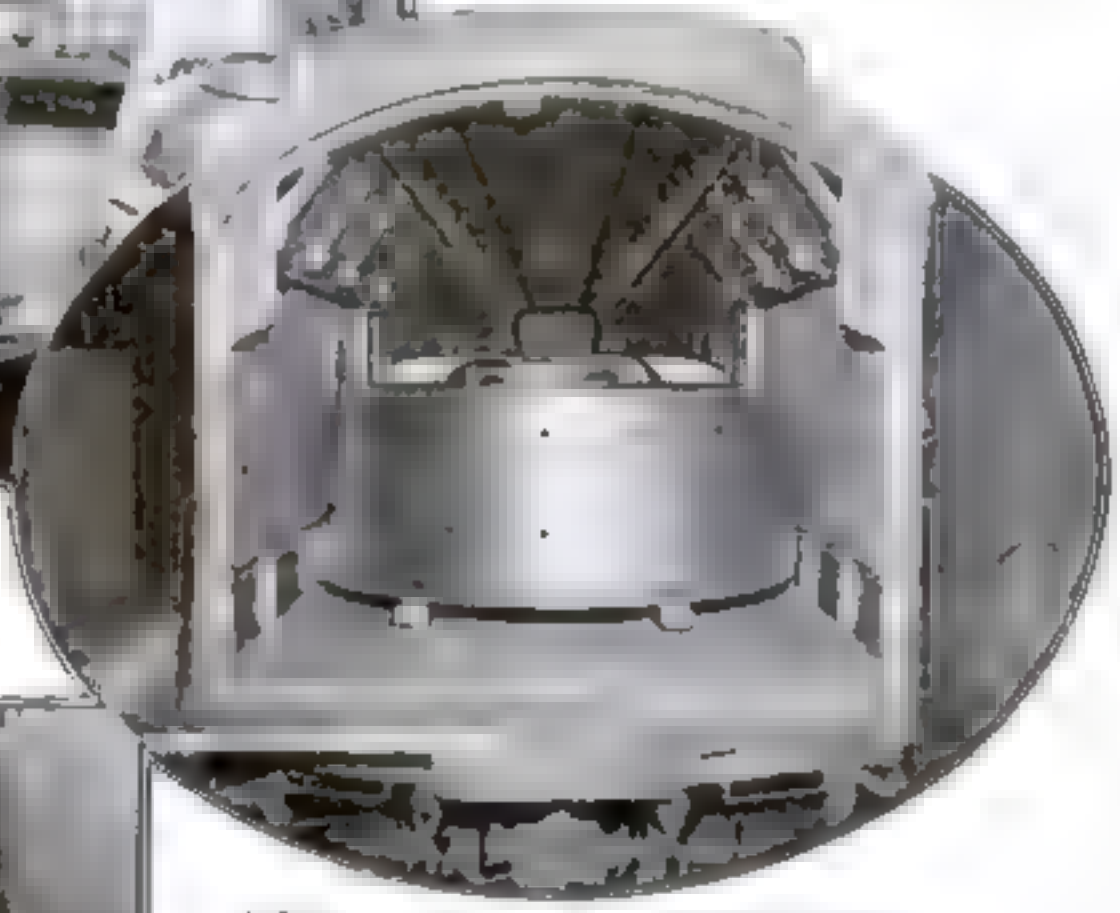
Notwithstanding the fact that the Owachomo Bridge in south western Utah, shown on the right, is called the "Little Bridge," it is one hundred and six feet high and nearly two hundred feet wide

The natural bridge of Santa Cruz, California, shown in the picture extending across both pages below, arches a perfect causeway, which has been formed by the inrush and outwash of waves during many centuries

Queer Uses of Railway Cars

At left, one of the rescue cars operated by the Bureau of Mines. Each car is manned by experts and is equipped with every device known to science that will aid in saving lives in disasters in the mines

Below, a breakdown in a copper mine made it necessary to secure three huge mill heads at once. The end of an express car had to be torn open to admit them



Below, a train-lighting instruction car which is a specialized school on rails for railroad men

Below, an express car turned into a printing plant where a daily paper was published en route to a convention

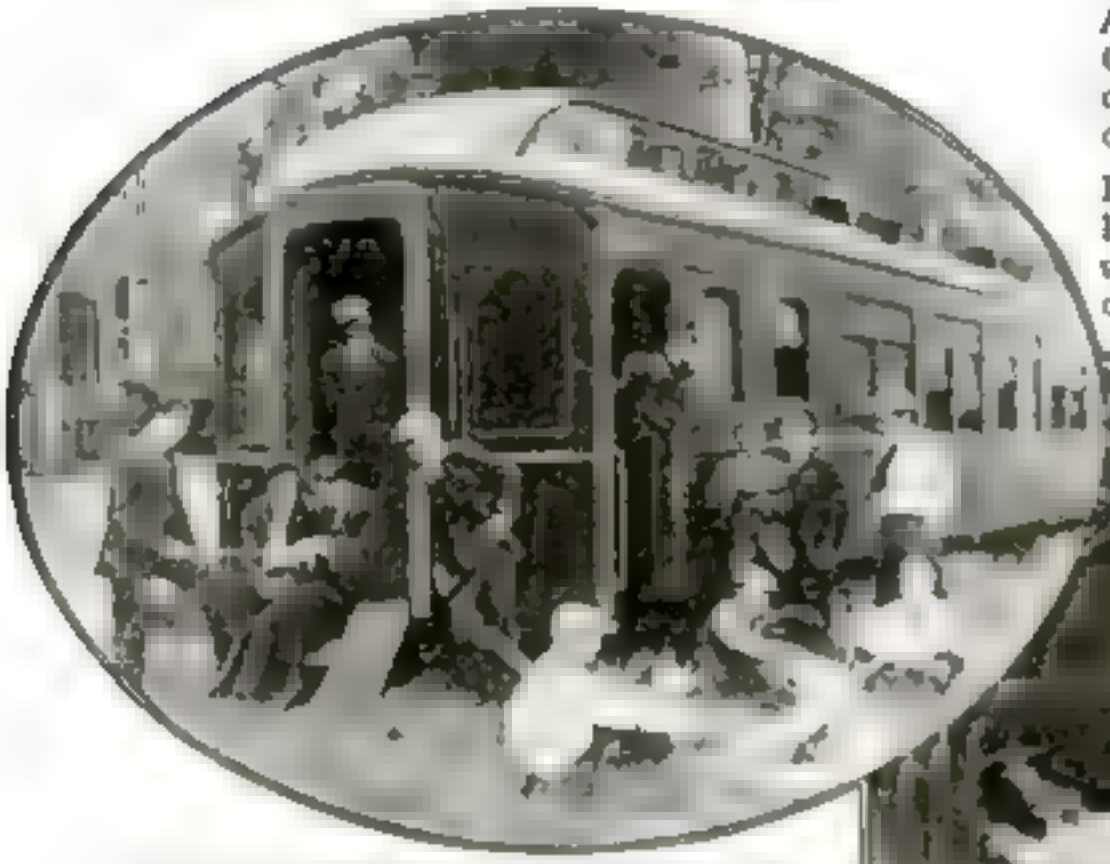
Queer Uses of Railway Cars

A traveling emergency hospital with an operating table, closets for medicines, washbasins, sleeping cots and all conveniences for giving first aid to the injured

A chemical test-car, the only one of its kind, is designed for making tests and inspections of steel rails at specified points along newly constructed railroad lines

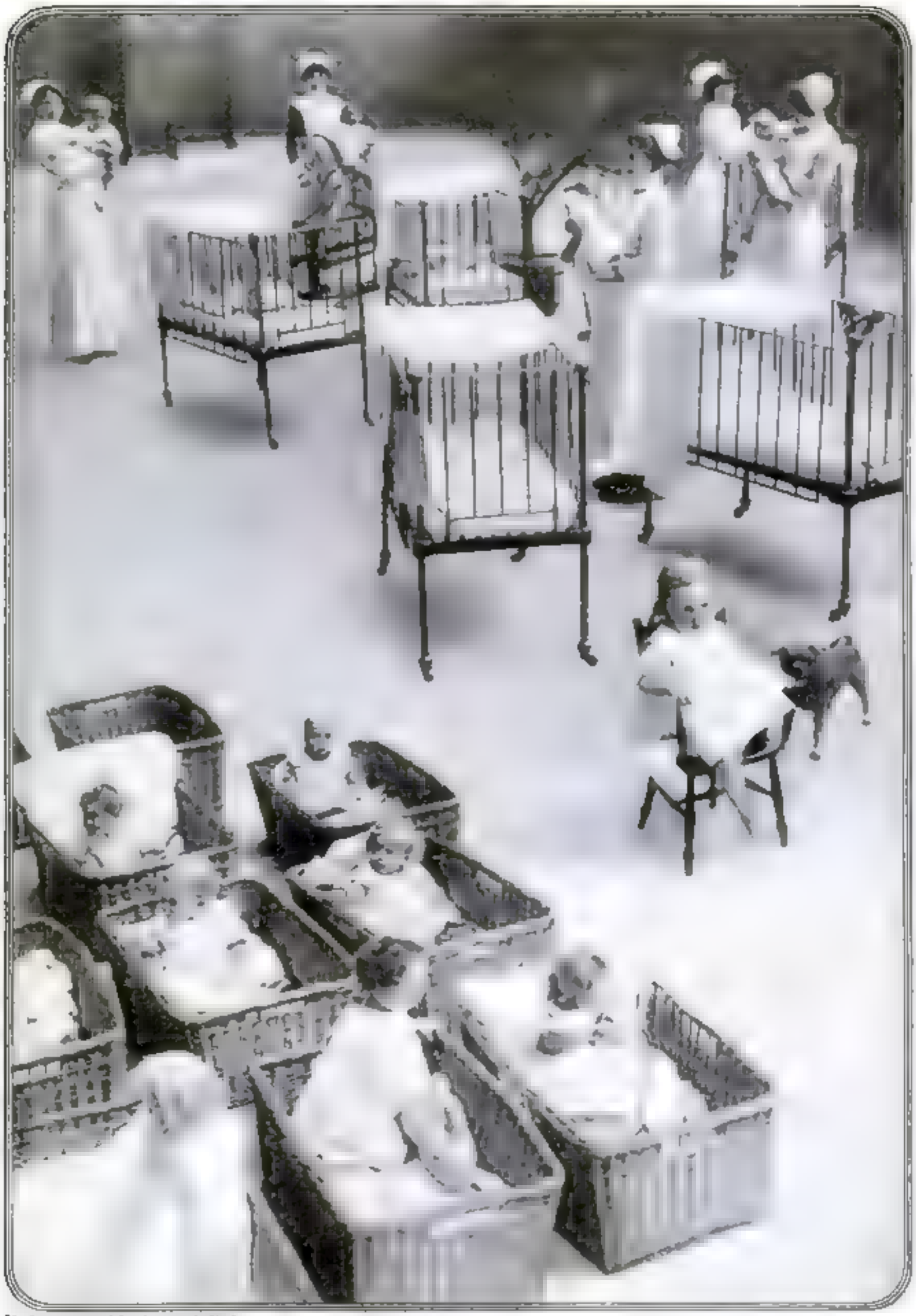
At left: The students of Blackburn College, Carlinville, Ill., are using discarded sleeping cars for dormitories during the spring and winter months

Below: Each coach has forty upper and lower berths, two drawing-rooms and two washrooms. The girl students are their own porters and make their own beds



Below: Removing one of the two cars used as dormitories from its tracks and placing it on the college campus. This car is used by the boys

How London Cares for Soldiers' Babies



Underwood and Underwood, N. Y.

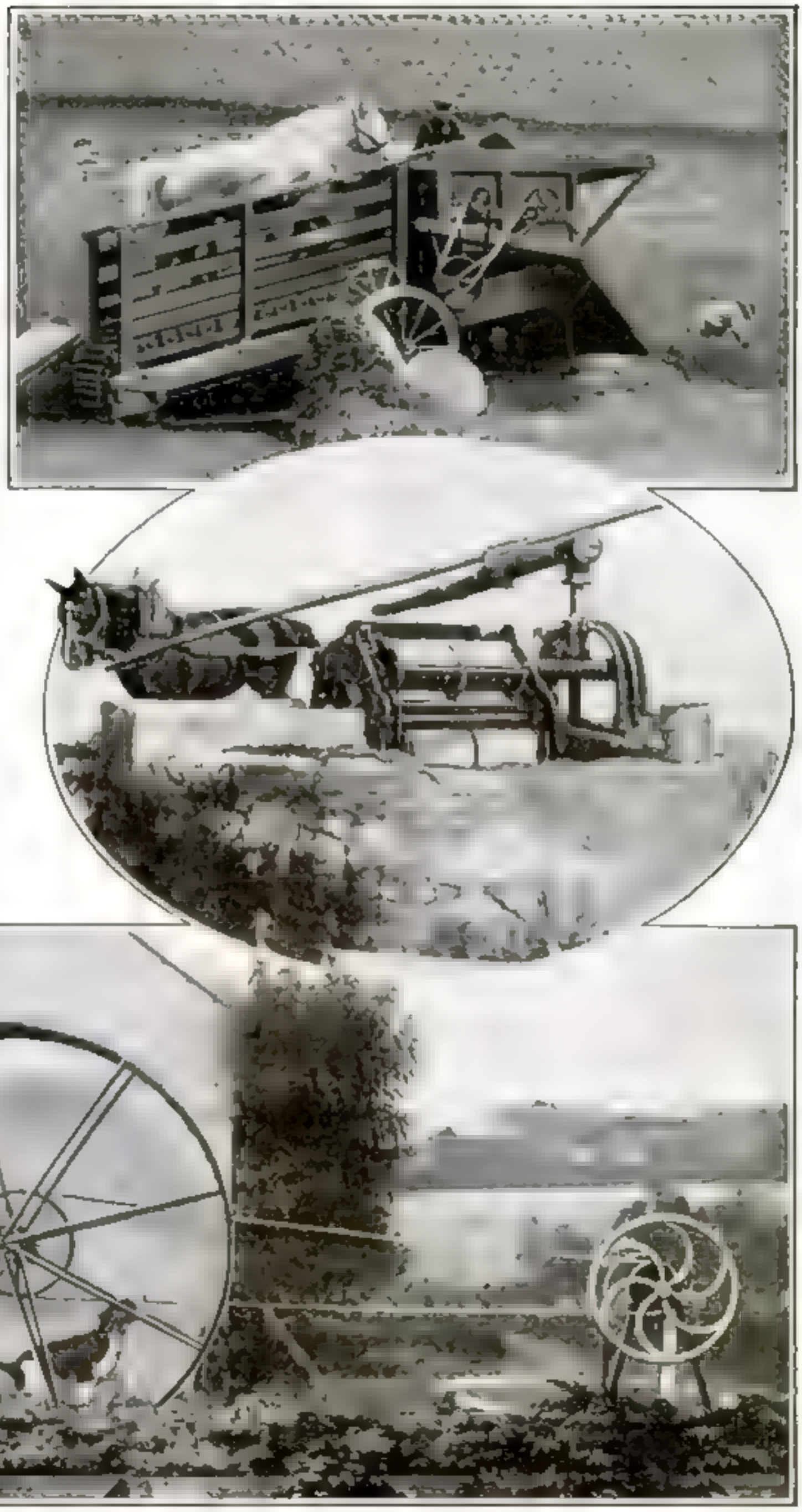
"War" babies in a London day-nursery. They will not know until later, or perhaps never, that father was away at the front shooting enemy soldiers with shot and shell provided by mother in the ammunition factory at home while they spent happy days in the nursery

And This in a Mechanical Age!

A horse driving a type of threshing-machine often found on small farms in northern France. Americans long ago outgrew this expensive and wasteful method of obtaining driving power

The second picture shows a water-wheel driven by a horse attached to a gin. It irrigates a small farm near Toulouse, France. Horizontal troughs receive the water drawn from the well. The ancient Egyptians invented this abomination

Below: A dog-treadmill used in France. The wheel is belted to a pump which raises water into a market-gardener's tank, near Orleans



Lost Comets and Their Story

By J. F. Springer

PERHAPS the most mysterious of all the heavenly bodies are the comets. Some are never seen except with the telescope, or else they appear as faint starlike bodies in the sky; others blaze forth, grotesque and fantastic of figure and brilliant in appearance, to excite and appal the ignorant. But always, whether dim or glorious, the appearance lasts but a moderate period at the most, and then the visitor is gone.

Astronomers make observations with instruments of precision and seek to follow the departed heavenly body by prolonging the ascertained path of its movement. And there has been a good deal of proved success in this work. For astronomers have in the case of some comets found that the orbit was a closed curve—an ellipse—and have thus been able to state in advance the time when and the place where a return would occur.

The most notable instance of a comet which continually returns is that of Halley's Comet. This remarkable body rushes through space in an elongated ellipse of such size that three-quarters of a century elapses between visits.

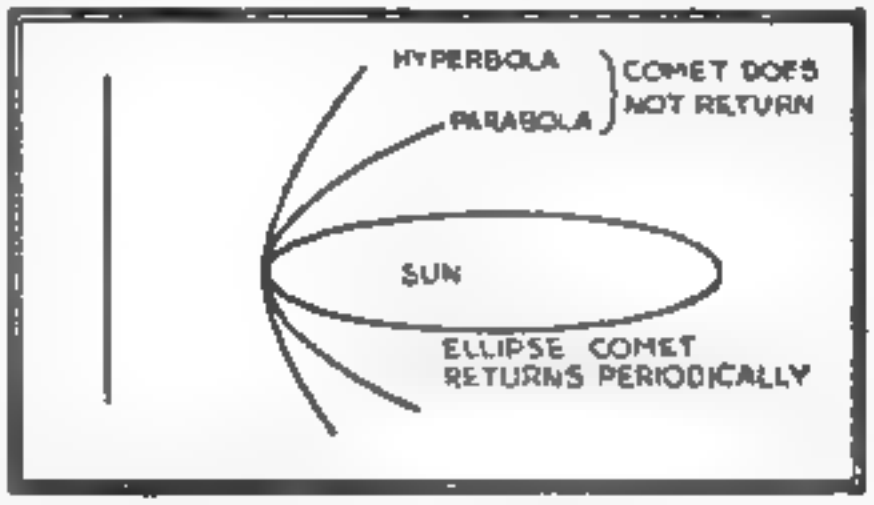
But there are comets which dazzle the sight for a period and then disappear never to return. Still others begin as regular visitors and then fail to reappear. Those comets which dart in from the outer regions of the solar system for a single glance at the earth and its inhabitants we are content to let depart without any especial concern. But when a comet makes regular visits and then disappears irrecov-

The comets blaze forth in fantastic glory occasionally exciting both curiosity and awe

erably, we are apt to feel perhaps that something has gone off from us whose place was with us. It is a case of a *lost comet.*

Thrown Off the Track by Jupiter

In the summer of 1770 a monstrously large comet appeared. Its apparent area was twenty-five times that of the moon. Astronomers made observations from time to time during its sojourn of several months. Difficulty was experienced in determining whether the comet was traveling in an open or a closed curve. If the orbit was an open curve, then there would be no reappearance as long as this character of orbit was followed. Finally, however, the astronomer Lexell succeeded in establishing that the comet was moving in an ellipse and that it should return in five and one half years. It is not known that this comet ever did really return.



Sir Isaac Newton proved that a heavenly body controlled by our sun moves in an ellipse, a parabola or an hyperbola

There was so much ascertained about its movements during its short stay that astronomers were reluctant to give up this comet of Lexell's. Investigation showed that, before its appearance in 1770, the comet had probably been forced into a somewhat different path from that which it had been following. In 1767, it had come within range of Jupiter's influence which may very well have modified its orbit into the curve noted by observation during the visit three years later. It was thought by Burckhardt, a French astronomer, that probably another passage near Jupiter had resulted not in creating a smaller orbit but in enlarging the ellipse. The new path that was calculated required the comet to reappear once in a period of sixteen years. However, the comet has never again been recognized. Lexell's Comet is for the present a lost comet.

In each of the years 1772 and 1805 a comet was observed. Again, in 1826 Biela, an Austrian officer, discovered a comet which was soon ascertained to be very probably identical with the comet seen in the earlier years. This body became celebrated from the fact that calculations showed that upon its next return in 1832 it would pass the orbit of the earth at a distance of only twenty thousand miles. A slight derangement of its orbit and it might approach more closely still. If the earth should be in the immediate vicinity at the time, then our planet's own attractive power would probably result in the comet coming into collision with us. The figures showed, however, that the comet would reach the region of close approach a month earlier than the earth. It seems, though, that it was a close shave. People at the time appear to have been stirred up over the possibilities. The comet came into view again at the period expected, but no untoward results occurred.

Forty years later, in 1872, the comet, according to the astronomer, Klinkerfues, actually *came into contact with the earth.* He telegraphed to another astronomer his statement as to contact and suggested a search in a certain definitely named locality of the heavens. Here, the second astronomer actually saw *some* comet, but was unable because of unfavorable conditions to carry his observations very far. It is uncertain whether he saw Biela's Comet. If he did, then he was the last observer of that remarkable heavenly body.

Enough happened, however, in the forty years, 1832-1872, to lead us to think that very probably Biela's Comet has disappeared forever as a comet and that it is now a stream of comparatively tiny bodies. This statement requires explanation. In the first place, Biela's Comet broke into two separate parts, each becoming a complete comet. The two bodies traveled more or less closely together for a number of years. That there were two comets instead of one was first observed in 1846. While under observation by astronomers at this time,

Halley's Famous Comet

This is Halley's Comet—the most famous of periodic comets—photographed at Yerkes Observatory during its last appearance. The stars in the background appear as straight lines because the camera was moved to follow the rush of the comet across the line of vision

the larger or more brilliant of the two was seen to have three tails arranged at equal angular intervals about it. One of these tails extended over to the smaller comet and formed some kind of connection with it. There was in fact a bridge of light between the two. The two comets were again seen in 1852, when they were still traveling along together. The interval between them, which was less than 200,000 miles in 1846, had now increased to 1,270,000. The comet seems never to have been certainly seen since this occasion. But, what was certainly seen was a great shower of "shooting stars." These luminous meteors seemed to radiate from just about the point where the orbits of Biela's Comet and of our earth cross each other. The date of the star-shower was some twelve weeks later than the time when the comet itself should have made the crossing. What these facts, when considered in the light of still other information of an astronomical character, mean is probably this: After 1852, Biela's Comet broke up into small bits of matter. These possessed individually the onward motion of the comet and were held in restraint by the sun (and any nearby planets), so that the pieces generally followed the orbit which the comet itself had been pursuing. The result was a long stream of very small heavenly bodies. When on November 27, 1872, a part of this stream came within the reach of the attractive power of the earth, the separate bodies fell through our atmosphere. The friction of the enormously rapid movement resulted in heating them up to incandescence. These fragments of the original comet thus became luminous meteors or "shooting stars." In 1798 and 1838, there were notable showers of stars at times and places which were near the position and time calculated for Biela's Comet for those years. These showers, in contradistinction to that of 1872, seem to have preceded the comet, itself. In fact, putting everything together, there would appear to have been a stream of small bodies five hundred million miles in length.

The foregoing suggests that when a comet is lost, the real fact may be that it has burst into multitudes of fragments.

Another comet which belongs to the list of the lost ones was first discovered in August, 1844. Apparently, Di Vico was the first to get even a telescopic glimpse of it. However, the comet rapidly approached our neighborhood, so that it was not long until it was visible to the naked eye. Di Vico's Comet was found to be traveling in a closed, or elliptic, orbit of such a character that it would return once in every period of a little less than five and one half years. The next return would accordingly be in the early part of 1850. Unfortunately, the comet, if it really returned, was too unfavorably situated with respect to the sun to be seen. However, in 1855, conditions would be advantageous. But no comet was seen then. Nor has this body ever certainly been seen since.

What Became of the Comet of 1264?

One of the most notable of the heavenly bodies which have more or less title to a place amongst the lost comets is the comet of 1264. This body engaged the attention both of Chinese and European writers. In 1556, another great cometary vision was seen in the sky in Europe and in China. Astronomers who studied the available data concluded that the two were one and the same comet. Calculations indicated that the period of revolution about the sun was somewhere in the neighborhood of three hundred and two to three hundred and eight years. Consequently, this great comet should have reappeared in 1858 or within a few years afterwards. It has, apparently, disappeared forever. In the year 975, a great comet was seen whose course has been thought by one astronomer to have possibly been that of the comet of 1264 at that time.

It is of interest to note that a comet may disappear because its elliptic orbit has been deranged into a parabola or an hyperbola. Sir Isaac Newton showed that a body controlled by our sun moves in a curve which is some one of the sections of a cone—that is, either an ellipse, a parabola or an hyperbola. As the latter two are open curves, a comet which pursued such a path would go off into space never to reappear. A derangement of orbit from closed to open curve has doubtless happened often.

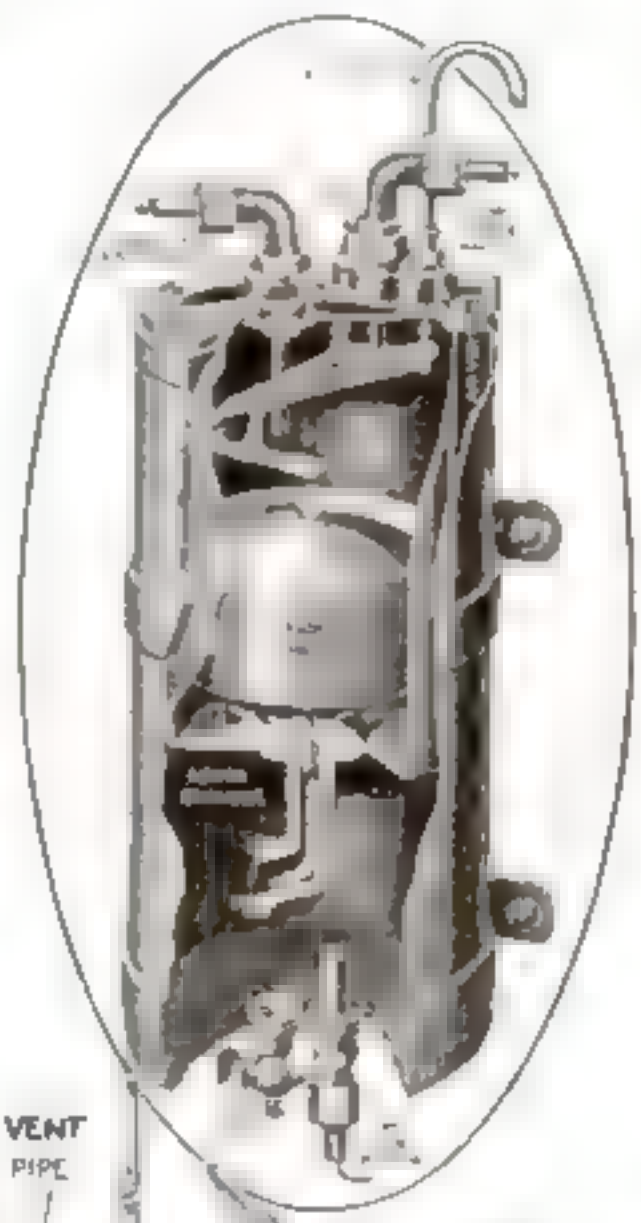
Pumping Gasoline to the Motor

A WESTERN manufacturer is marketing a device designed to eliminate the troubles encountered in the feeding of gasoline to the motor of an automobile from a tank by gravity during hill-climbing, when the carburetor is higher than the tank, or for keeping the feed-lines from leaking when the pressure system is used. It feeds the gasoline automatically and positively by utilizing the vacuum of the motor on its intake-strokes. The vacuum system feeds the gasoline on the steepest grades. It is not dependent upon the tightness of the feed lines for its operation, as in the pressure system.

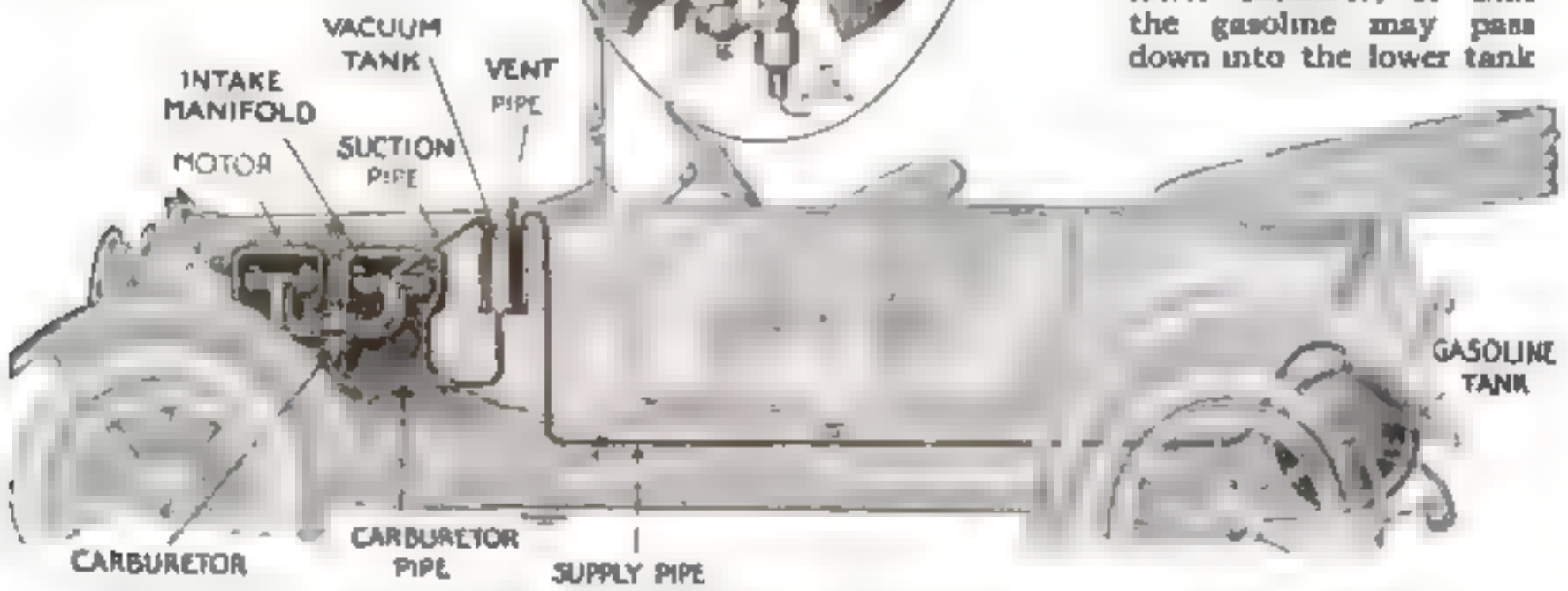
The device consists of two small tanks, one within the other, usually mounted on the dash under the hood. The upper inner tank is connected with the intake manifold, while another pipe connects it with the main gasoline-supply tank. The lower tank is connected with the carburetor.

The intake-strokes of the motor create a vacuum in the upper tank. Gasoline rushes from the supply tank to fill the vacuum. As the gasoline thus flows into the upper tank, it raises a float to a certain height, thus shutting off the vacuum-valve, at the same time opening an atmospheric-valve at the bottom of an air-vent pipe as shown in the accompanying illustrations.

By this arrangement the gasoline can now flow down into the lower tank, which is always open to the atmosphere by means of an air-vent at the top. When the float in the upper tank drops, as the gasoline flows down, it automatically re-opens the vacuum-valve. More gasoline is sucked in, and simultaneously the atmospheric valve is shut off. A study of the illustration in the oval will make this clear. The process is repeated continuously while the motor is running, and however steep the grade there should be no trouble encountered in the feeding of gasoline to the motor.



Detail of the vacuum gasoline feed. When a vacuum is created by the motor on each intake-stroke gasoline rushes into the upper chamber. The float-valve rises with the gasoline, cuts off the vacuum-valve, and opens the valve leading to the lower chamber, so that the gasoline may pass down into the lower tank



Sectional view of automobile. An arrangement whereby the vacuum created by the motor on its intake-strokes causes a flow of gasoline to the motor, thus eliminating the feeding trouble usually encountered on steep up-grades with the gravity or pressure systems

Decoy Ducks that Quack and Swim

The ducks are composed of two separable parts which enclose a phonographic contrivance which emits a natural-sounding quack, or call, at predetermined intervals

WHEN Amos C. Vaughan of Anadarko, Oklahoma, goes duck shooting he takes with him a set of his mechanical decoys and places them in the water in front of his blind. Before doing so, however, he winds them up. When a flock of wild ducks appears his decoys begin to swim about and quack as if they were alive. The result is that the inventor goes home with a full bag, for no wild duck can resist the mechanical wiles of his decoy.

His duck is provided with a phonographic means for automatically giving at predetermined intervals a call or cry. It swims about in the water with the aid of the propeller and an adjustable rudder, either in circles or in any direction the hunter wishes.

The decoy is composed of two parts, bottom and top, which can be opened for cleaning and repairing. A clockwork mechanism drives the propeller and also the sound-record of the phonograph. As the mechanism is set in action the stylus, or needle, as well as the propeller is operated. A cylinder or disk is used for the record. A controlling cam renders the needle inoperative at certain intervals, so that the calls or cries are sounded intermittently. Who makes the phonographic record of the quack that leads a duck to its doom? We are baffled.

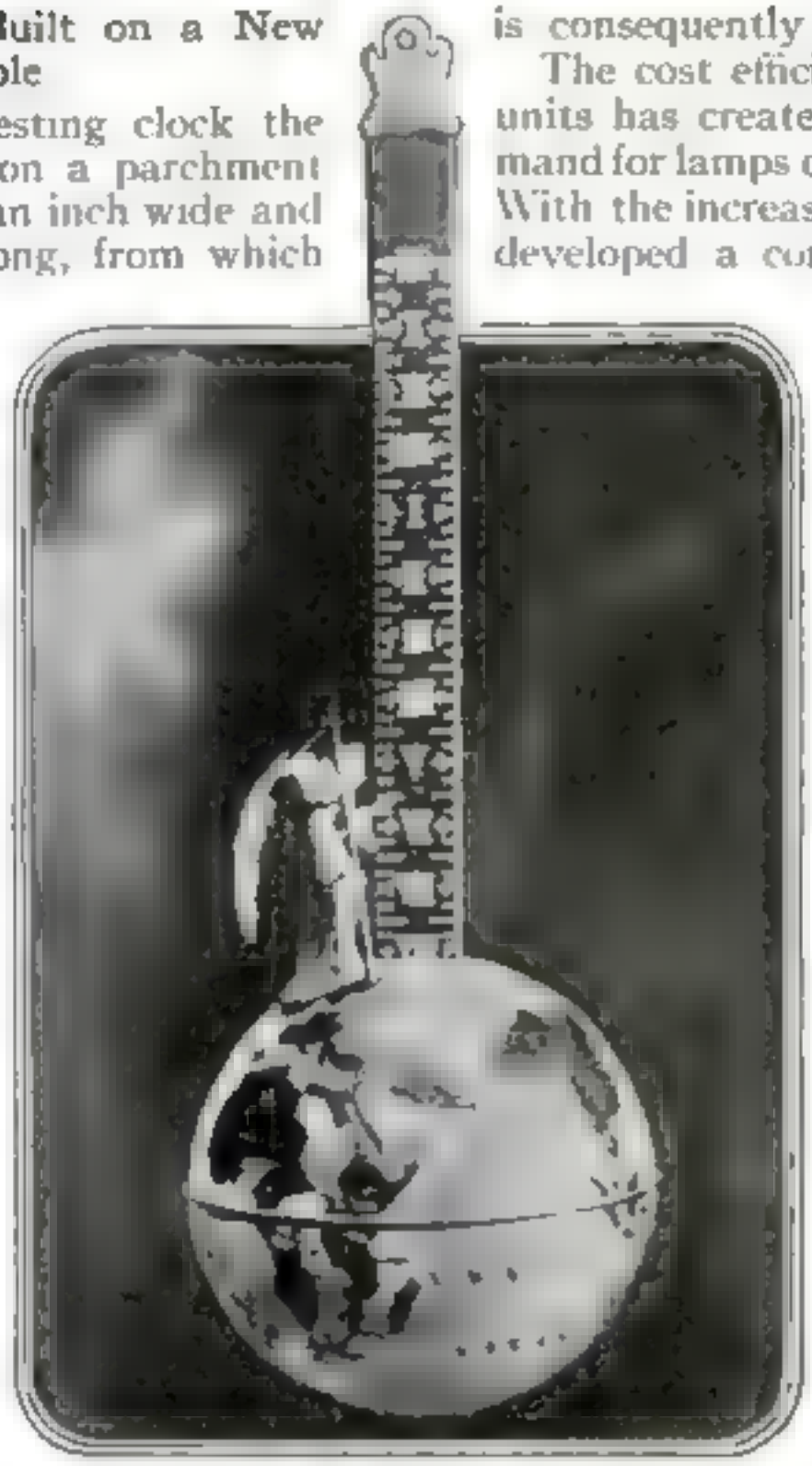
A Famous Outdoor Organ

When Festival Hall was demolished along with the other buildings at the Panama-Pacific Exposition, the famous organ was removed to San Diego, where it remains a permanent attraction used for outdoor concerts, as the gift of Rudolf Spreckels

A Curious Clock Built on a New Principle

IN this very interesting clock the time is recorded on a parchment strip five-eighths of an inch wide and eighteen inches long, from which the ball is suspended. The time is indicated by a figure of Father Time placed at the edge, his fingers pointing to the hour. No mainspring drives the clock, the motive power being supplied by the total weight in the moving ball and Father Time. A lever controls the movement.

As soon as the ball is suspended the clock begins to go and continues to go until the eighteen inches of parchment have been unwound, at the end of thirty hours. To rewind the clock, the ball is simply lifted up to whatever the time may be. If lifted too far it can be pulled down. It does not drop for it is kept in position by a friction spring. A small mainspring winds up the strip.



Father Time points with his finger to the hour and the clock has no need for any other "hands" to designate the exact time

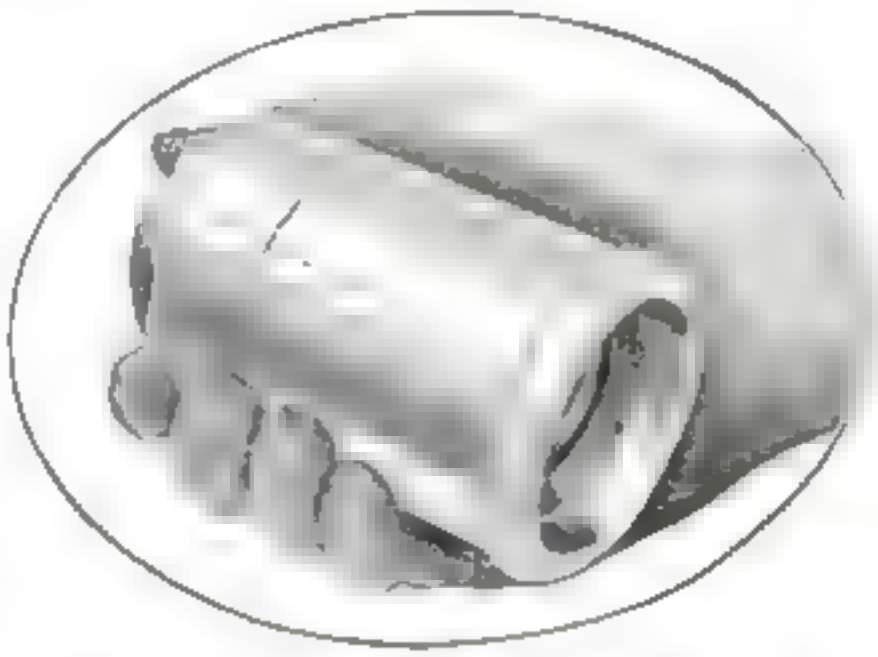
A Heat-Resisting Socket for High Wattage Lamps

THE tremendous wattage necessary for the high candle-power lamps now so generally used, has put the illuminating engineer to the task of devising a socket capable of "standing up" under the intense heat which is consequently generated in them.

The cost efficiency of high-light units has created an increasing demand for lamps of large candle-power. With the increased wattage there has developed a corresponding percentage of breakdown in lamps and sockets which is due to the intense heat developed.

The socket shown in the illustration at the bottom of the page is larger than the usual lamp receptacle, with a casing built especially strong to withstand almost any kind of rough usage.

The conducting paths are insulated and sealed with a compound said to be capable of withstanding any heat to which it is likely to be subjected in service.



The socket is larger than the usual receptacle for the lamps and has a strong casing

The Money Value of Two Great Discoveries

IF WE count the wealth of North America and South America as it seems to-day, we find that the discovery of America by Christopher Columbus has been worth to the world three million dollars a day from the time he sailed from Palos in August, 1492, down to the present time. Likewise the man who discovered the way of drawing tungsten wire gave three hundred million dollars' worth of light yearly.

This tree was probably pinned down beneath a piece of heavy timber or fallen tree-trunk when it was a mere sapling

At right, a branch of an old sugar-maple has been incorporated in the body of an adjoining tree about fifty years younger

Freak Trees. How Did They Happen?

TO the person who is not versed in forest lore the grotesquely bent tree trunks that are to be found in almost all woods are mystifying and wonder is often aroused as to the cause. Foresters will tell questioners that in the case of trees in mountainous country and other sections where the snowfall is heavy, the weight of snow is responsible in most instances for the queer twists they assume. When a tree is young the weight of snow that falls on its branches often bends the trunk over until it is flattened to the ground. Sometimes it is buried under six or eight feet of snow and held in that position so long that when warm weather comes the tree fails to spring back into it normal position. The summer sun causes the tip of the young tree to turn upward and if it manages to withstand the weight of the snow of the next winter, that portion of the tree will, as a general rule, continue to grow in a normal way. "Hair-pin" bends and other odd shapes result.

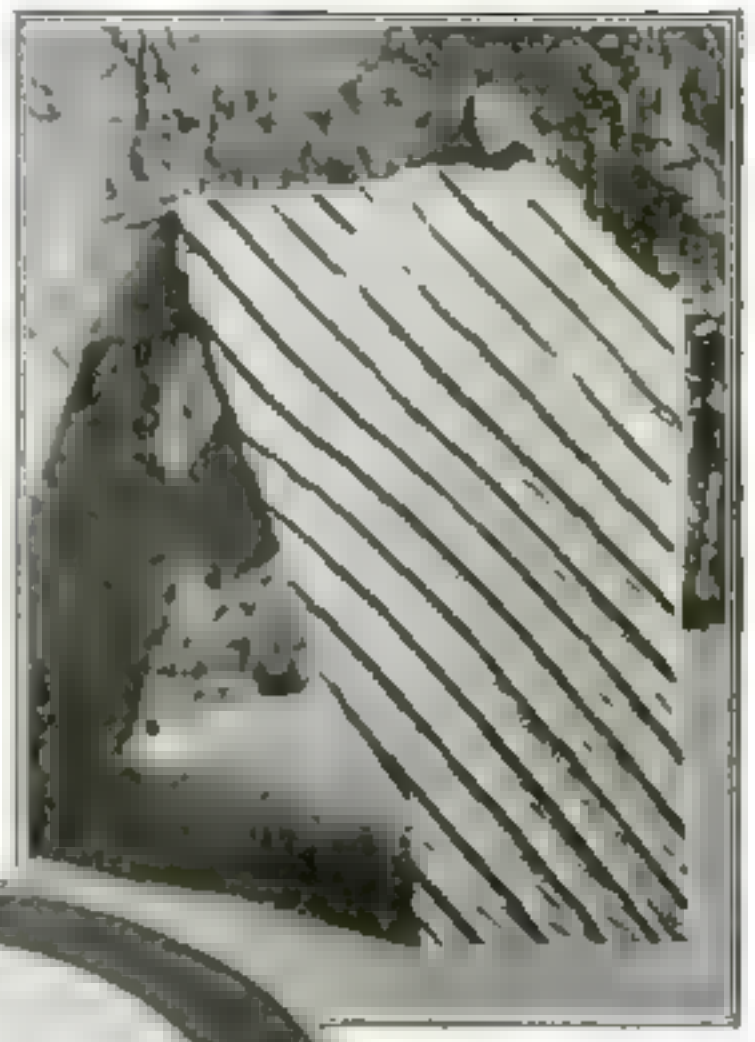
The bending over of a small tree under the weight of a heavy branch or tree-trunk that falls on it also results in producing these seemingly freakish formations.

A curious tree stands on the top of Tunnel Hill, Johnstown, Pa., about four miles from town. It is a sugar maple about one hundred years old which has prolonged its own life by grafting a branch into a much younger tree.

A Slab of Sandstone Seventy-Five Million Years Old

A SLAB of sandstone stands on edge in the bed of an Ohio stream. It has peculiar markings made in times past by ripples when the stone was soft sand. The layer of rock from which this slab was broken extends far back into the bank of the stream, and comes to light again in a quarry a mile distant. In fact when the ripple marks were formed it was the soft sand of an ocean shore.

In short the pictured slab is a piece of what geologists call Berea sandstone, formed from ancient sediments at least seventy-five million years ago. To-day the Berea sandstone beds are of importance because great quantities of oil and gas are found in them.



A slab of sand-rippled Berea sandstone of practically incalculable age

A Curious Egg Shaped Like a Dumb-Bell

THE freak egg shown in the picture on the right was laid by an ordinary Leghorn hen. When first laid it was a perfect dumb-bell in shape, having two yolks, one on each end, connected by a sac enclosing the albuminous portion.

The freak egg compared in size with a normal egg laid by the very same hen

The inner bone formation of a whale's ear picked up by a Scandinavian fisherman

Would You Recognize the Ear-Bone of a Whale If You Saw One?

HERE is an actual photograph of a natural object. Does it remind you of a human face, exaggerated as in a cartoonist's drawing?

But it is only one of those freaky resemblances so often seen in natural objects or formations.

The photograph represents one of the ear-bones of a whale, an object about three times the size of a hen's egg. A whale has a most complicated ear mechanism, composed of several bones and ossicles of different sizes, interlocked by curious angles and facets. Sometimes one of these bones is cast up on the beach. The photograph represents such an ear-bone picked up by a fisherman on some sandy beach on the Scandinavian peninsula; and by a curious coincident it looks most like the type of face sometimes seen among the lower classes of Scandinavians.

Putting Wheels Under Workmen Saves Time and Money

THE problem of interior and exterior transportation in one of the largest and busiest ammunition plants in this country—a plant, by the way, which was constructed in eleven months—has been solved by the adoption of automobiles, motorcycles, motor-trucks, hand-trucks, roller-skates and bicycles. The plant is worked at high pressure for twenty-four hours a day, and consists of thirteen main units and twelve service buildings, each with a main corridor one-half mile long. To inspect the various shops entails a walk of nearly ten miles, exclusive of the stairways. The combined floor area is a million and a half square feet. Between seventeen and eighteen thousand employees are on its payroll.

If it is necessary to dispatch messengers on important errands, or if the automobile used for such duty is out of repair, the motorcycle is pressed into use.

When a boy on the ground floor of building "A" is given a note to deliver on the top floor of building "M" he takes his bicycle on an elevator to the fifth floor, mounts it, and is off on a run of two thousand feet. If not detained by the party to whom the note is addressed, he can deliver his answer to the person sending the message within seven minutes from the time he began his journey. Had he depended upon his legs, the same trip would have taken him at least twenty-five minutes.

Bicycles enable an express messenger boy service to be carried on in large factories

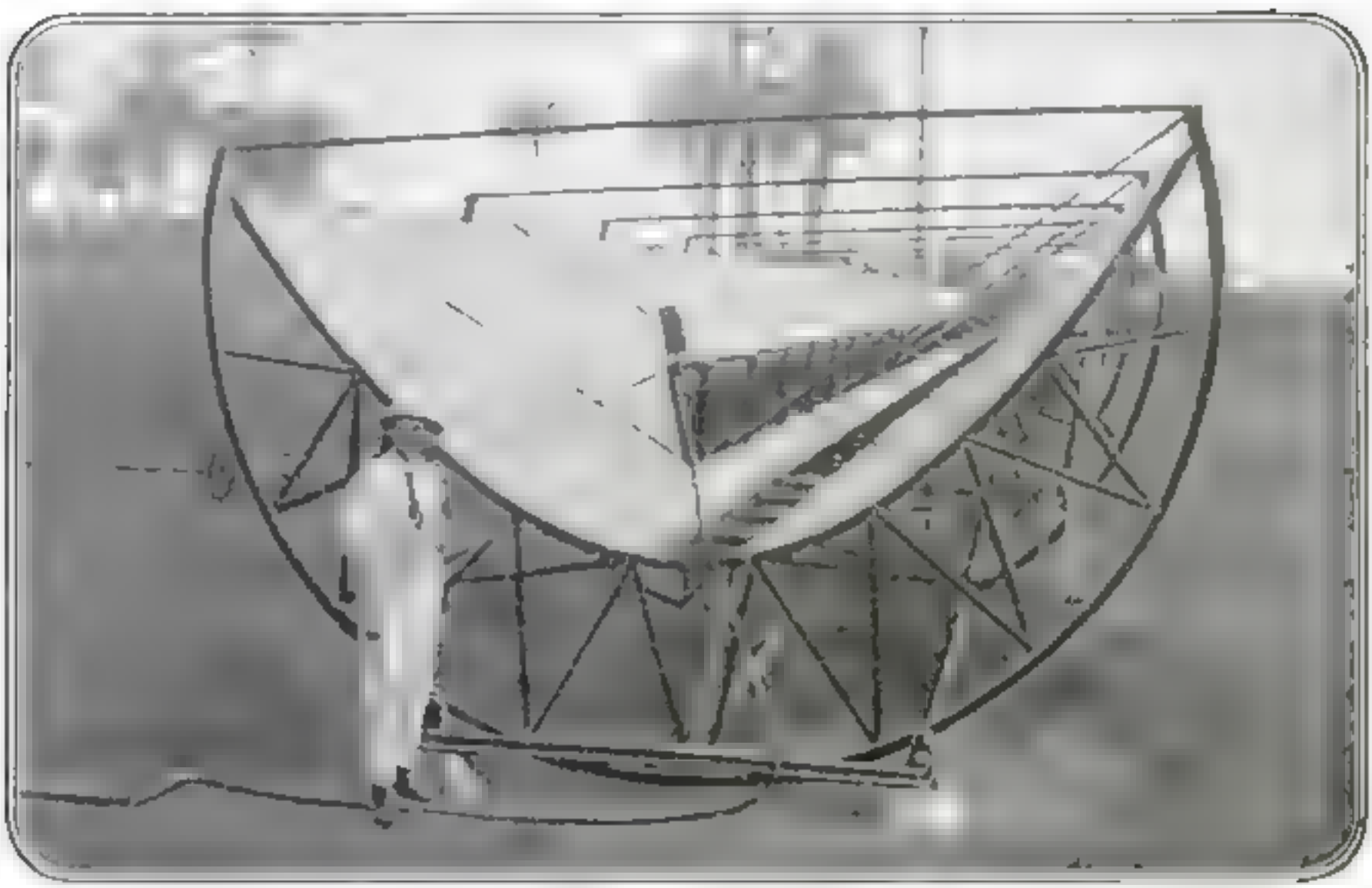
The Old Fondness for Cycling Is Coming Back

CYCLING is being revived in Grand Rapids, Mich., and members of the club there have installed a unique apparatus in the Y. M. C. A. gymnasium to encourage the sport. It consists of two frames, supporting rollers, which are connected by a speedometer tube with a miniature one-half-mile track. The tube governs two miniature figures of riders which follow the circumference of the track. Bicycles placed on the rollers are ridden by athletes and the miniature figures respond readily. Races are run daily, with starters and timers officiating. The apparatus registers the time accurately and at the finish of a race each rider is given his correct time over the distance.

Two miniature bicycle riders race around a miniature track, their speed corresponding to that of the athletes on the bicycles over the rollers

Harnessing the Sun

By Waldemar Kaempffert



In the Sun Power Plant which Mr. Shuman erected at Maadi, near Cairo, Egypt, steam is generated by parabolic mirrors set in a light steel framework so as to throw the sun's rays upon a long trough through which water flows in a shallow stream. Thus steam is generated on the same principle applied in a greenhouse to prevent plants from freezing

IF a boy can burn his name on a wooden bench with nothing but the aid of a convex lens and the sun's rays, why is it not possible to make the sun boil water, generate steam, and drive an engine? It seems absurd to burn coal costing from three dollars to thirty dollars a ton, depending upon your latitude and longitude, when the earth is deluged with heat.

The thought of using solar energy for generating power has occurred to many an engineer. John Ericsson, the inventor of the "Monitor," made more than one attempt to harness the sun. In his mind's eye he saw a desert tract nine thousand miles long and one hundred miles wide, extending from the Northern coast of Africa as far as Mongolia, and great arid regions running from the southwestern part of the United States through Central America and along the coast of South America for a length of a thousand miles, animated with millions of throbbing engines deriving their power from the sun. On a rainless strip eight thousand miles long and one mile wide enough solar heat is wasted, he figured, to drive twenty-two million, three hundred thousand solar engines of one hundred horse-power each, nine hours a day. Why, he asked, why should not upper Egypt derive signal advantage from its fortunate desert location and attain a high social position because of its perpetual sunshine?

For thirteen years Ericsson worked with diligence born of optimism. Between 1865 and 1878 he built no less than seven solar motors. Instead of a lens he employed mirrors, which were fastened on a movable frame and which concentrated the sun's rays on a boiler, when he was driving his engine by steam, and on an air-chamber, when he employed a hot-air engine. Although he

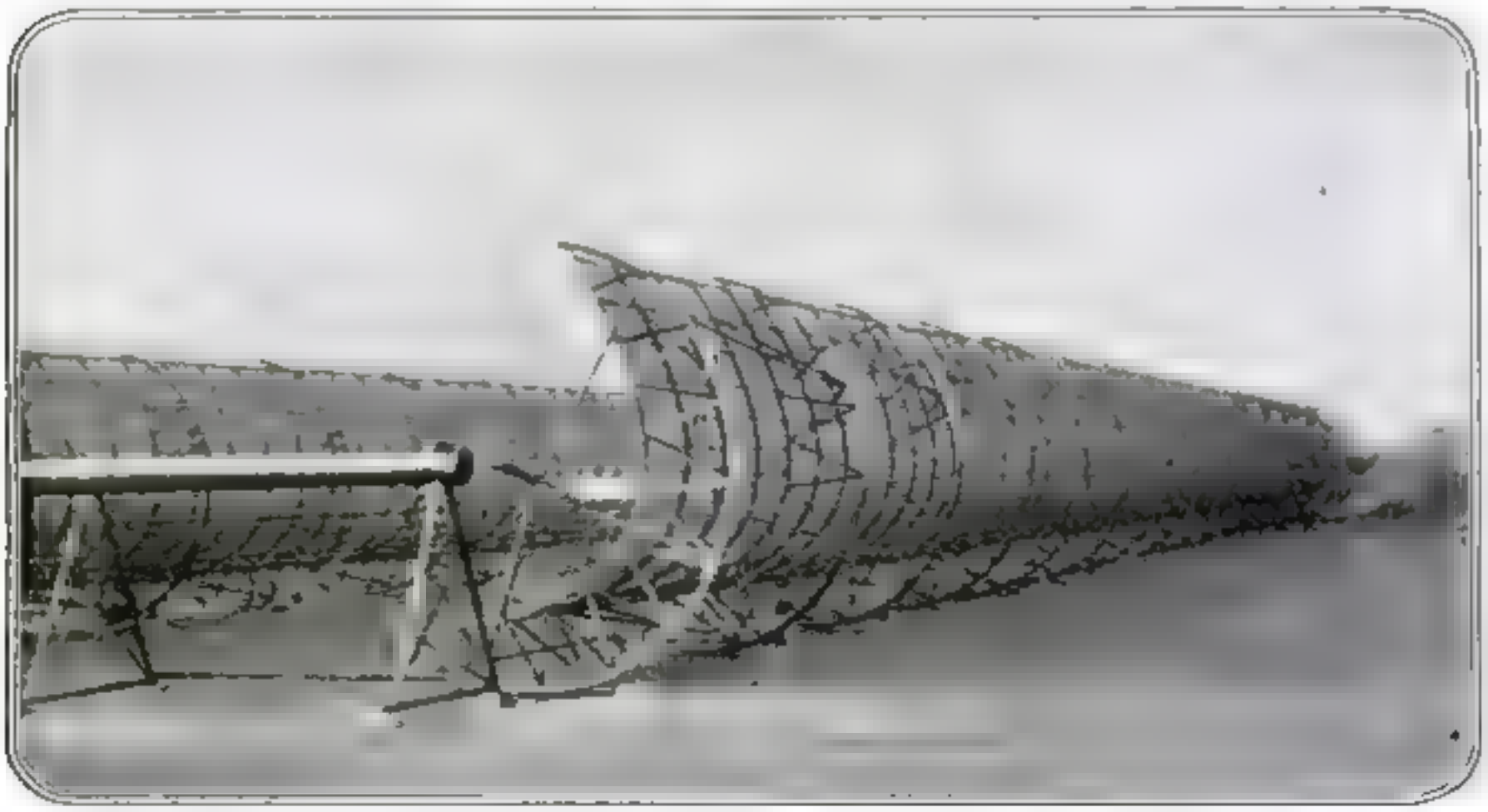
succeeded in developing about one horse-power for every one hundred square feet of reflecting surface he abandoned his plan in disgust. "The scheme is impracticable on account of the great cost of the needed apparatus," he declared. "The fact is that although the heat is obtained for nothing, so extensive, costly and complex is the concentration apparatus that solar steam is many times more costly than steam produced by burning coal."

Even if much water could be boiled by mirrors, enough, let us suppose, to develop a thousand horse-power, it does not necessarily follow that the sun motor will supplant the steam engine. Factory machinery must sometimes be driven at night. How can the solar motor do that? In the desert of Sahara the sun does not shine at midnight.

Evidently the inventor of a solar power plant must design a storage system—a piece of apparatus that can be charged with excess power and tapped at will in sunless periods. Ericsson slaved on this phase of the problem as much as he did on the invention of the engine itself. Yet his results were unsatisfactory. Some of his successors have designed machinery to compress air in strong, steel tanks; some have planned systems in which a dynamo is made to charge a storage-battery; and some have thought of pumping water into a reservoir from which it could subsequently be drawn to turn a water-wheel. Compressed air machinery, storage-batteries, and pumps cost much money, even though the sun's heat may be had for nothing—so much money in fact that a boiler and a steam engine may prove cheaper in the end.

Askance though he might look at a colleague who really believed in substituting sun's heat for coal, an engineer could not deny that Ericsson had none too vividly pictured the possibilities that await the successful inventor in desert lands. After making due allowance for the absorption of the atmosphere, the total energy received by the earth in one day from the sun amounts to about 341,600 million million horse-power—equivalent to about two hundred and thirty million horse-power for every inhabitant.

To obtain these figures some instrument for measuring the sun's heat was obviously employed. Ordinarily solar heat is mercifully radiated and carried away as fast as it is received; otherwise the sea would have boiled away long ago, and every living thing on the earth



The parabolic reflectors which serve to concentrate the sun's heat upon a trough of water at their focus move automatically with the sun. This solar plant is capable of giving an average of fifty horse-power. Were it located farther south, it would yield energy amounting to about sixty-five horse-power, making due allowance for the absorption of the atmosphere

would have been reduced to a mere cinder. If the amount of heat received is to be measured, this radiation must be checked. A heat trap must be designed. One of the earliest instruments made for that purpose was devised by the late Professor Samuel Pierpont Langley, of the Smithsonian Institution, somewhat on the lines of a gardener's greenhouse. His heat trap was simply a box provided with a double glass pane and packed with cotton to reduce loss of heat by radiation. The layer of air between the two sheets of glass served as a heat insulator, and the glass itself prevented the heat which entered the box from escaping. On Pike's Peak, where the thermometer recorded fifty-nine degrees Fahrenheit, the temperature in the box rose to two hundred and thirty-five degrees. Had he succeeded in trapping all the heat, which is practically impossible, he might have obtained enough to melt solder. Since Langley's time, experiments conducted by Mr. C. C. Abbott of the Smithsonian Institution have given much better results.

These facts having long been known, it has occurred to more than one inventor that a solar power plant might prove successful if constructed on the principle of the gardener's greenhouse and Langley's box. Mr. Frank Shuman has given us a type of solar power plant in which a thin film of water is heated in a cast-iron trough surrounded by window glass. So intense is the heat impounded by the double glass that the water is quickly raised to the boiling point (two hundred and twelve degrees Fahrenheit) or very near it.

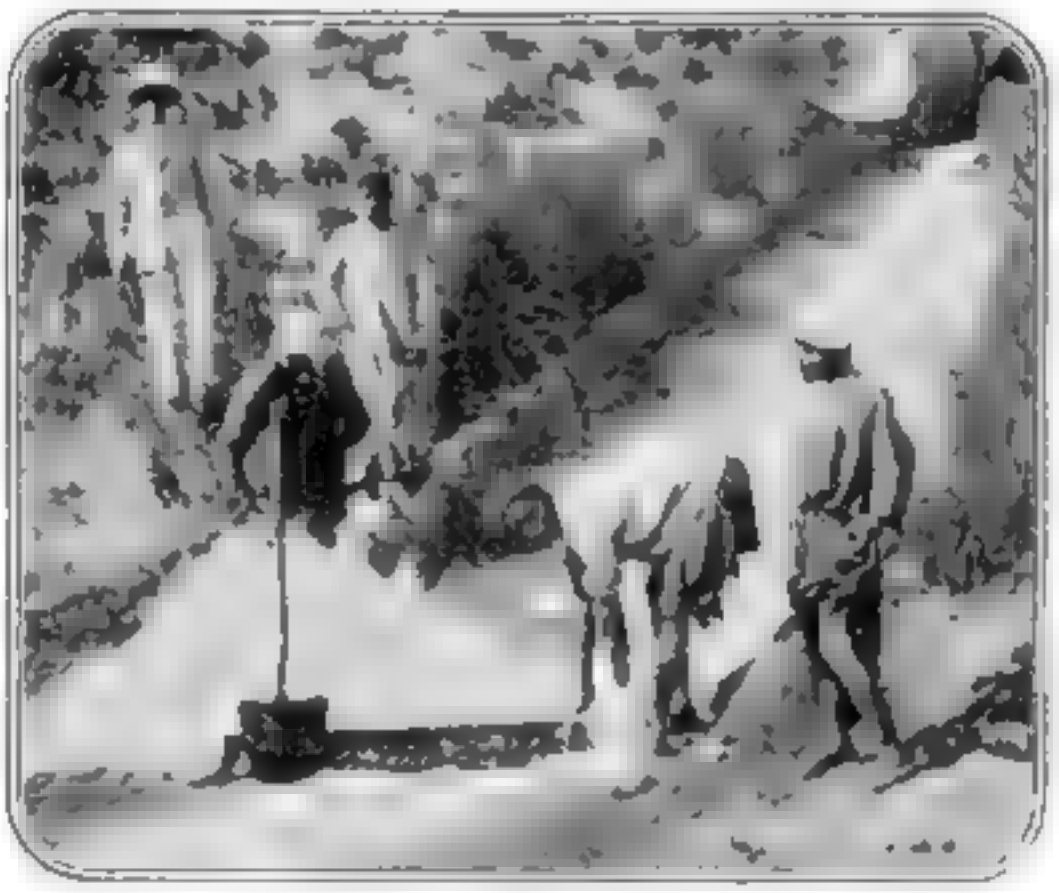
After the water is brought to about the boiling point in the trough, it is conveyed to a steel storage-tank in the inventions of Mr. Shuman. That tank is not simply an enlarged covered pot, but a vessel so constructed that as little heat as possible can escape from the water within. Just as we keep ourselves warm in winter by wearing clothes to prevent a too abundant radiation of our bodily warmth, so Mr. Shuman swathes his storage-tanks in an insulating material which keeps the water hot for many hours.

But how can an engine be driven with nothing but hot water? Mr. Shuman performs the feat by the paradox of making the water boil without flame after he has stored it. Thus he generates

The water which is heated by the parabolic reflectors is stored in well-insulated tanks. A low-pressure steam-engine was designed by Mr. Shuman which would take this hot water and use it to drive a piston even though the pressure gained was only four pounds absolute

steam which can be used in an engine of suitable design. It must not be supposed that he discovered the paradox, nor that he is the first to utilize it in a practical way.

When Tyndall in one of his most brilliant writings defined heat as "a mode of motion," he meant that the infinitesimal molecules of which all matter is composed are in a state of vibration. To understand his definition we must imagine the molecules of all bodies, even of so cold a mass as a block of ice, moving about at a high velocity. As soon as the temperature of the body is raised, its molecules vibrate faster, collide with one another, and are made to move in longer paths. Thus the phenomenon of expansion under the influence of heat is produced. When the temperature is raised still higher, so that the solid melts and becomes a liquid, the molecules move in paths so very much greater that there is less common interference. Lastly, when the liquid is made to boil, many of the molecules are actually thrown off, and strike against the walls of the enclosing vessel, so violent is their movement. The pressure of steam or of any confined gas, then, must be regarded as a phenomenon due entirely to millions and millions of blows struck by millions and millions of invisible infinitesimal molecules. If a thimbleful of boiling water were magnified to the size of a cathedral the steam within it might seem to a gigantic eye like myriads of bullets shot in all directions. Because countless bullets strike the walls of this huge thimble not singly, but at once in very rapid succession the effect of steady pressure is produced. A single finger tap may not even move an open door. A billion simultaneous finger taps will shut it—shut it, moreover, as if it had been pressed by a hand.



Water was easily pumped for irrigating purposes in Egypt by means of Mr. Shuman's Sun Power Plant

At what temperature the molecules will fly off from a boiling liquid depends entirely on the pressure to which the liquid is subjected. The atmosphere weighs down on all earthly things with a pressure that amounts to about fifteen pounds to the square inch at the level of the sea. If water is heated in the open air at sea level the flying molecules must be able to overcome that pressure; otherwise the water does not boil. The temperature at which they can fly off at sea level, at which water, in other words can boil, is two hundred and twelve degrees Fahrenheit. On the top of a high mountain where the atmosphere presses down with less force because there is less of it, the molecules will fly off much more readily than at the level of the sea, with the result that water will boil much below two hundred and twelve degrees. If it were possible to remove the pressure of the atmosphere at sea level altogether, water could be made to boil at the temperature of an ordinary room without heating it. That feat has actually been accomplished in the laboratory by pumping out the air in the water vessel.

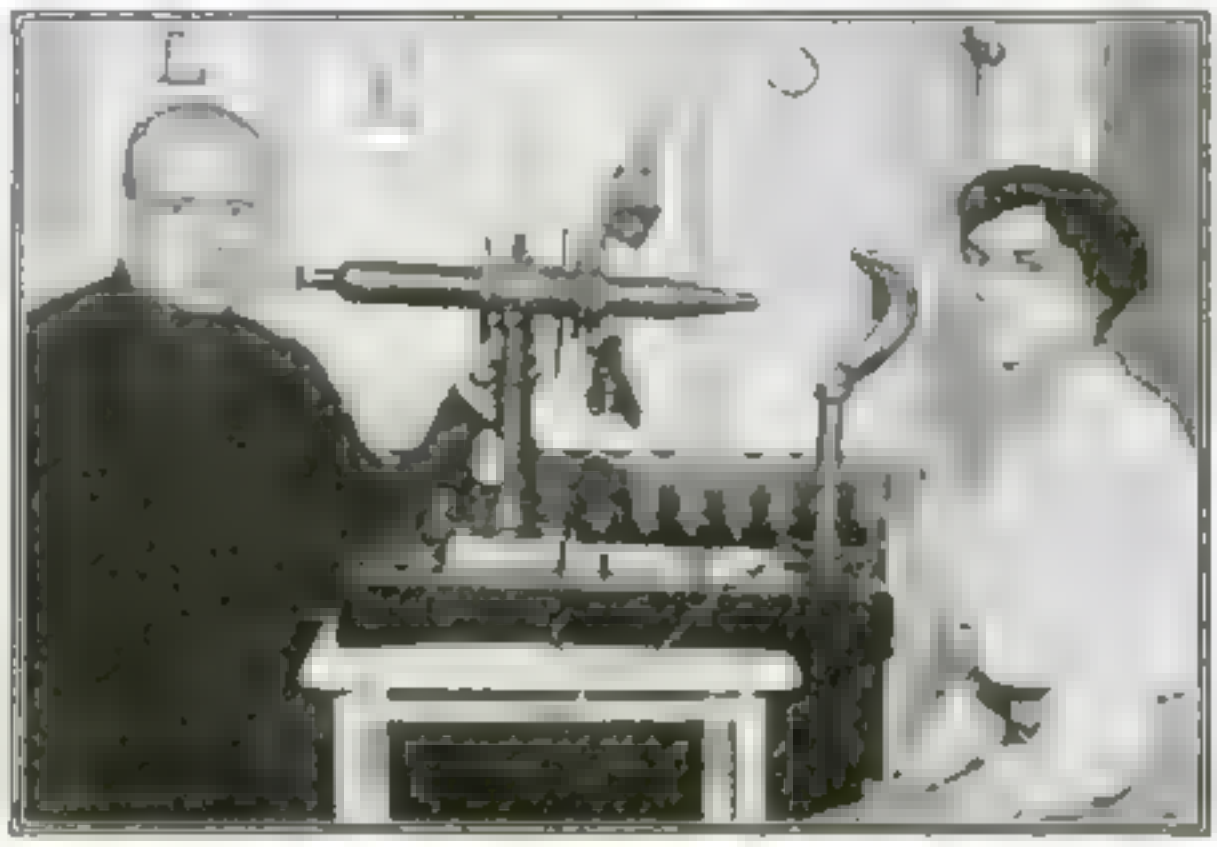
What Mr. Shuman has done, therefore, is to remove part of the atmosphere's pressure from the hot water so that steam may be generated. That steam he supplies to an engine which he has designed for the express purpose of utilizing steam at low pressure. After doing its work the steam is condensed into water and is passed back to the greenhouse-like heater.

Shipping Sugar-Coated Education by the Trunkful

BORROWING the idea of the traveling libraries, the Bureau of Visual Instruction, of the University of California, has perfected a plan for sending out trunkfuls of information and educational exhibits on interesting subjects. The exhibits illustrate processes by which raw wheat or oats are made into cereals, hides finished into shoes, lead and oil made into paint, snow converted into electric power, crude oil into fuel and lubricants, rubber into tires, graphite into pencils, hemp and flax into rope, etc.

The object is to intensify interest in places and products and in industrial and social development, but to do it in such an interesting way that the educative element will be completely wrapped up in the entertainment, as the medicated pill is seemingly lost in its sugar coating.

The particular exhibit illustrated here concerns the manufacture of paint. Slides containing the printed information covering all questions that might arise on the subject, are drawn out at the sides of the cabinet, while in the cabinet itself are slabs showing different tints and viols containing the different pigments and ingredients used. The stand is collapsible.



Preparing to examine an employee in the United States Treasury Department to determine the effect of the work on the eyes

A traveling-trunk exhibit showing the processes and materials used in making paint

Have You Perchance a "Vocational Disease?"

IN an exhaustive study which is being carried on by the United States Public Health Service a great many interesting things are being found out about the effects of various vocations upon government employees. For example, all of the workers in the Treasury are having their eyes examined to determine the effect of confinement upon the men and women engaged in making our money for us. These tests are being conducted by Assistant Surgeon-General Kerr.

In the accompanying photograph, Dr. George H. Collins, of the Public Health Service, is preparing to examine the eyes of a treasury employee. After he has made the test he will prescribe for her eyes, if necessary. An interesting sidelight of the investigation will show whether or not the lighting system of the Treasury Building is good. Steps are already being taken to correct many of the lighting faults that have existed.

Pocket-Flashlight Distress-Signals

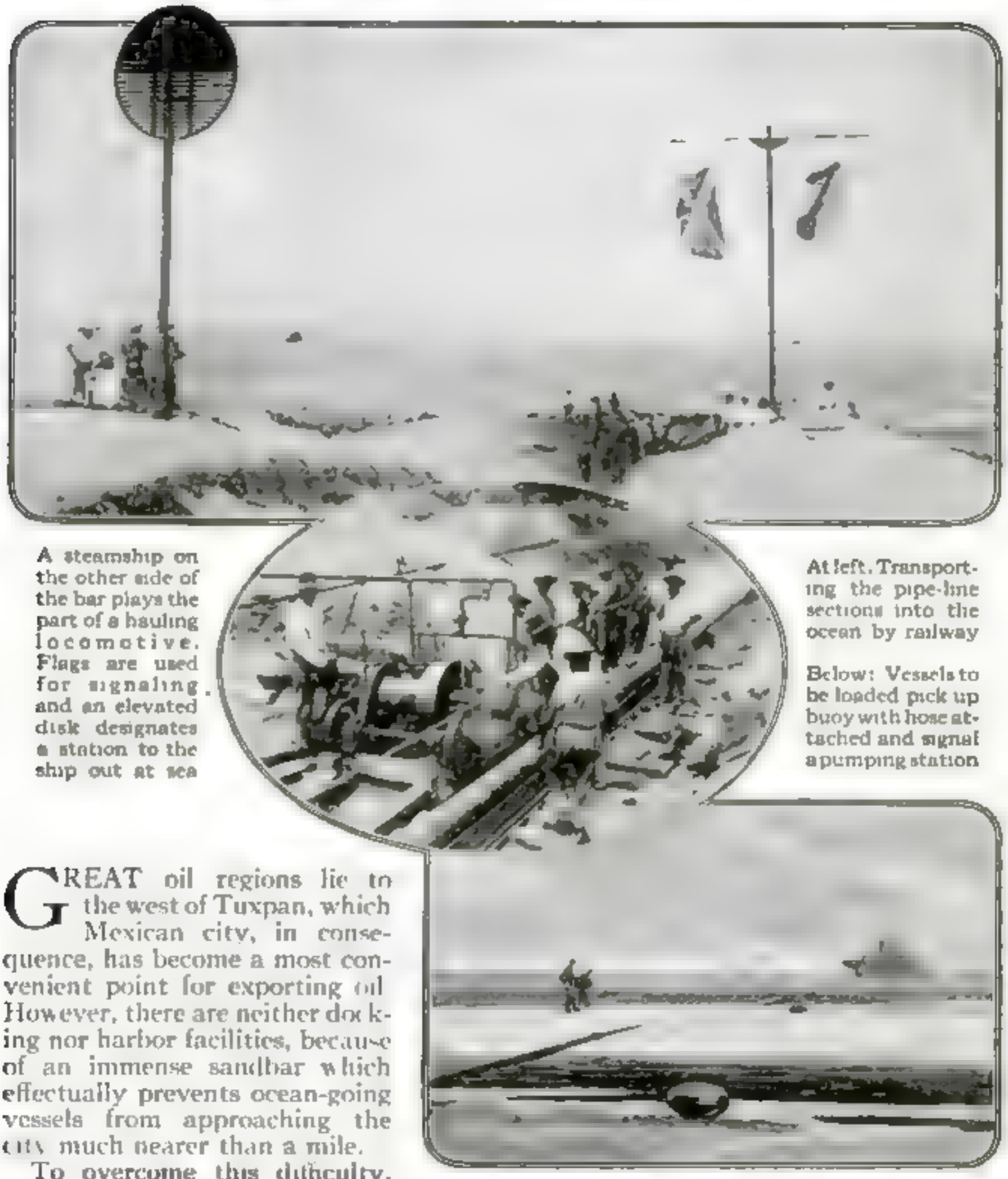
A NEW system of warning approaching vessels along the Atlantic Coast when danger is near and of signaling to craft in distress has been adopted by the United States Coast Guard. It involves the use of pocket electric flashlights instead of the flaring red torches formerly employed. The new light will permit signaling to vessels at greater distances than has heretofore been possible and will also make it possible to flash communications. Hence Coast Guardsmen can signal to a ship in distress its approximate position and tell the master the best course to safe water.

The flashlight consists of a heavy nickel plated barrel encasing a dry cell battery and having at one end a parabolic reflector fitted with a bulb containing a tungsten filament

Although only slightly larger than the pocket lamps in common use, the new light produces a flash that can be seen for seven miles in good weather. It consists of a heavy nickel-plated barrel encasing a dry cell battery. At one end there is a parabolic reflector about five inches in diameter. Fitted at the base of the reflector is a six-volt bulb with a highly concentrated tungsten filament. At the other end is a "key" or switch to turn the current on or off and flash the light. Messages are sent by long and short flashes, corresponding with the Morse code dots and dashes.

Recently Coast Guard officers made experiments with the new signal light off the Virginia Capes on a stormy night. Cape Henry light, which under good conditions is visible for nearly twenty-three miles, could not be seen for more than eight miles. The pocket flash could be seen four and one-half miles.

Piping Oil to Ships at Sea



A steamship on the other side of the bar plays the part of a hauling locomotive. Flags are used for signaling, and an elevated disk designates a station to the ship out at sea

At left, Transporting the pipe-line sections into the ocean by railway

Below: Vessels to be loaded pick up buoy with hose attached and signal a pumping station

GREAT oil regions lie to the west of Tuxpan, which Mexican city, in consequence, has become a most convenient point for exporting oil However, there are neither dock ing nor harbor facilities, because of an immense sandbar which effectually prevents ocean-going vessels from approaching the city much nearer than a mile.

To overcome this difficulty, the oil companies devised a novel method of loading oil. Long pipe lines were run out under the sea and over the sandbar. To the outer ends of these lines flexible elbow joints were attached. Nipples on the upturned ends of the elbow joints were provided for the attachment of rubber or other hose, leading from the pipe lines to the surface, their position being plainly indicated by large buoys.

In loading oil, vessels simply ride at anchor in the open roadstead, pick up one of the buoys with hose attached, signal a pumping plant on shore, and take on oil at the rate of one thousand, seven hundred barrels an hour. Even though the vessels roll, the intake of oil is not seriously retarded. Indeed, oil is taken aboard with almost the same

ease as if the vessel were tied to a wharf. Many thousands of barrels of oil are thus shipped from Tuxpan each year.

The success of the first lines at Tuxpan stimulated the installation of many others at, or near the port, until the submarine method of loading oil has become standard in the region. The method by which the pipe lines are laid is no less interesting than their function.

How the Pipe Line Is Laid

A trench is first dug through the sand dunes near the beach, until a smooth, even grade is secured down to tidewater. On this grade short ties are laid back from the beach. On these ties light rails are laid, the gage being less than a foot. On this narrow railway small cars or "dollies" ride. The pipe sections are connected on shore beside this narrow-gage track, lifted upon the "dollies," and thus transported into the ocean. A steamship on the other side of the bar plays the part of hauling locomotive to the dollies, a hauser being employed.

As a rule the lines are made up of 8-inch steel pipe and approximate a mile and a half in length. Frequently a small hoisting-engine has to be installed along the track to aid the steamship at sea in pulling the line By fastening a cable back of a coupling on the line and running it over one of the drums on the hoisting engine, substantial aid can be given in this work of hauling.

The fog-stick is run out from the steamer on a steel towline by means of a pulley

A Fog Stick Guide for Traffic on the Great Lakes

IN very foggy weather the barges towed by steamers on the Great Lakes are often lost to sight, so that the safety of both steamer and barge is jeopardized. The fog-stick shown in the accompanying illustration was designed to meet this condition. It is sent out from the steamer on the steel towline by means of a pulley or block, and is run up close enough to the barge to be always visible to the man at the forward wheel and to indicate the direction in which the towline is leading and consequently the relative position of the steamer.

Rope guys hold the fog-stick at the required distance from the bow of the boat and a weight composed of a bag of sand keeps it upright. At night, or whenever the fog is thick enough to warrant it, a lantern is suspended from the pole.

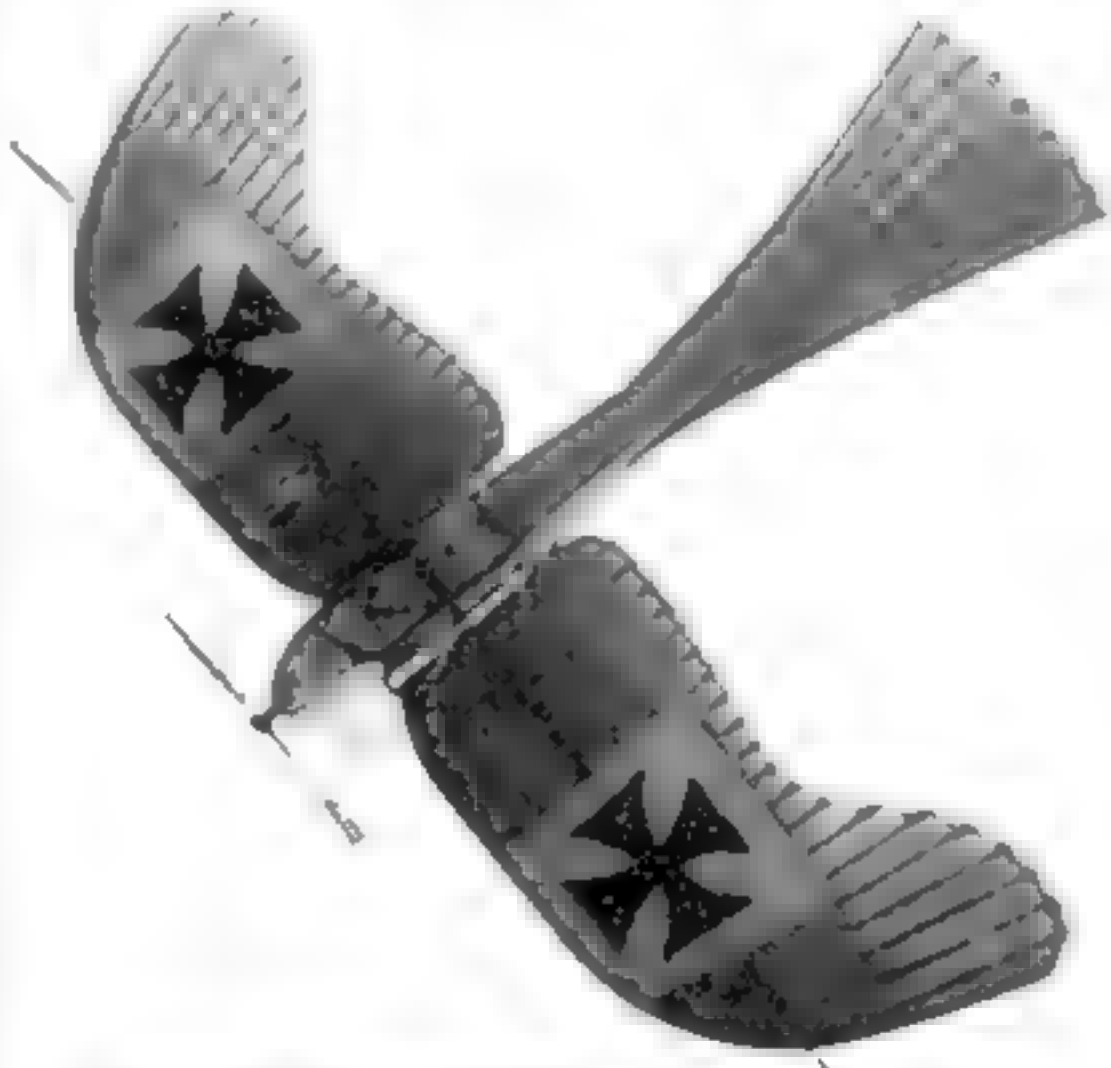
Why the Color of Sea Water Is Blue or Green

WHY is the ocean blue? Because of the reflection of the sky? This accounts for some of the color but it is largely a matter of saltness and density. In the tropics where the intense heat and rapid evaporation cause the water to be much saltier the blue is vivid, while the further one goes toward the poles the greener the hue becomes until it is almost as vivid as the tropical azures.

War Progress in Flying

By Carl Dienstbach

THE way aeroplanes were flown before the war seems almost ridiculous now, after men have really learned how to fly as the result of war's exigencies. The old way made them an easy prey for anti-aircraft guns and for attacking machines. When it became necessary to dart out of the range of a high-angle battery, which had suddenly revealed its presence with bursting shrapnel, or when only a quick maneuver could prevent a hostile machine from blocking the way home, the old-fashioned, steady, level flyer and slow climber proved a very death-trap.



A German "Taube" in flight. We hear less of Taubes now than we did at the beginning of the war. They were standardized machines, and the war upset all preconceived aeroplane standards

Looping-the-loop, caper-cutting, all the acrobatic performances that attend exhibition flying became normal evolutions. Only excess power for a sudden burst of speed and climbing would avail in a perilous moment.

A fast-climbing machine, which also has the virtue of exhibiting great lifting power in the thin air of high altitudes, naturally vaults into the air easily in a difficult start on rough ground. In a critical landing—when, for instance, the ground, which, from above seems invitingly smooth, turns out to be alarmingly rough—the fast-climbing machine can easily stop its swift descent and leap lightly over an obstacle. By reducing his power while the machine is flying at a steep angle, the pilot may even touch the ground at a very low speed.

Salvation Lies in High Power

A machine thus able to deal with rough ground is most stable in rough air. An aviator fears what he calls a "hole in the air"—a pocket formed by a downwardly-twisting current. Into such a hole he drops in a sickening way because his wings no longer have an upward blast to support them. He saves himself, not by trying to climb out—a useless proceeding—but by *steering downward*, thus increasing his speed and likewise the pressure beneath his wings. "To go up, one must sometimes steer up, at other times steer down," Wilbur Wright told me in his little insignificant bicycle shop in Dayton, Ohio, in 1905, in discussing the low-powered Wright machine.

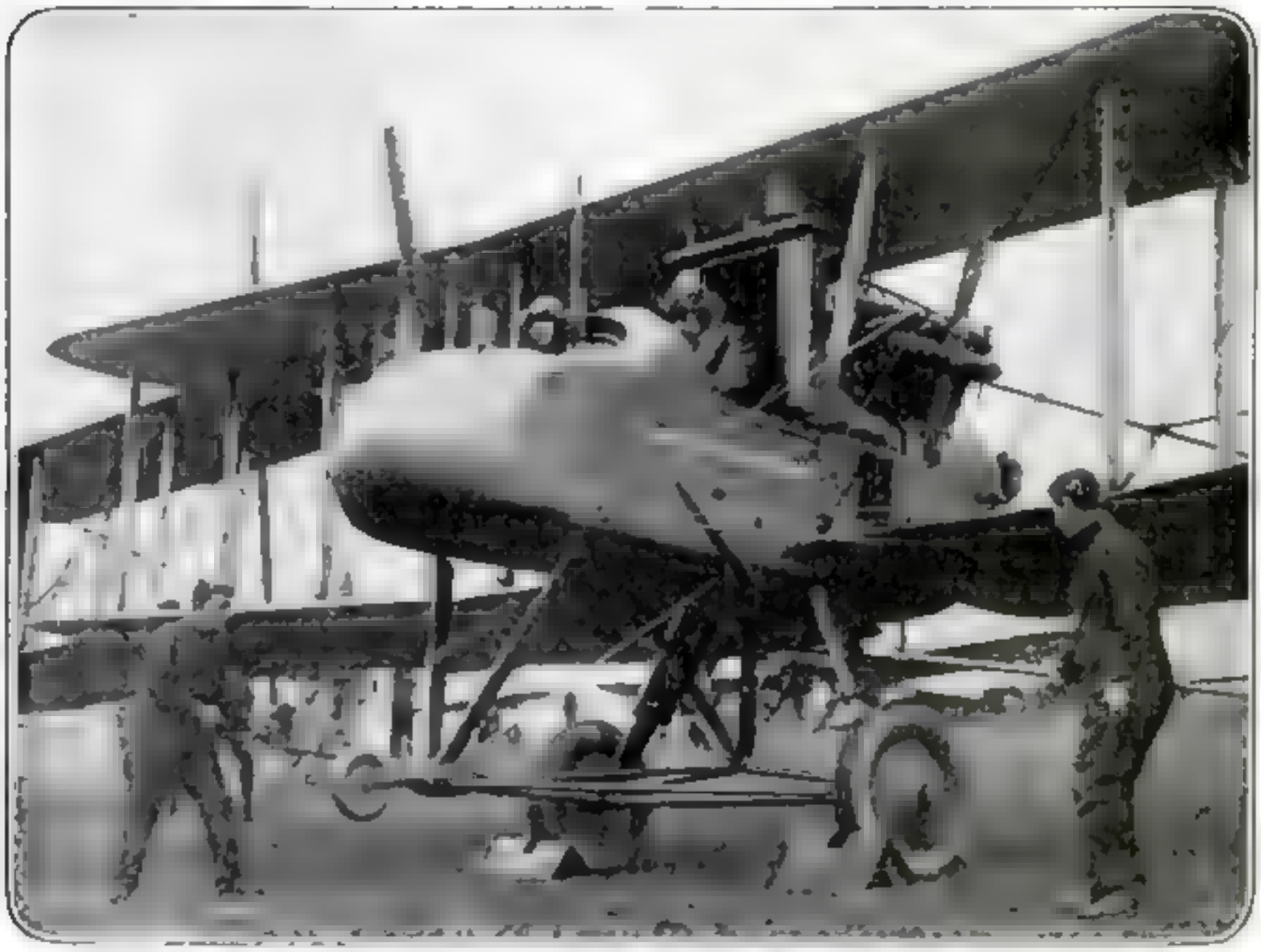
Evidently the aviator needed power to combat these difficulties. This he obtained by resorting to surplus-powered and reserve-powered machines. There would seem to be no distinction between the two terms, but the difference is this: the surplus-powered machine has a motor which is more than able to make it fly and the excess power of which is constantly used for normal flight; the reserve-powered machine uses its excess only in an emergency.

In the surplus-powered aeroplane, "steering down to keep up" is not a praiseworthy maneuver. A pilot cannot possibly know how far the "hole" or local descending current extends and whether he will not plunge into the ground before he gets out of it. But with the reserve-powered machine, it is otherwise. When it steers up, it goes up—always; and what is still more important, it goes up instantly. The words "goes up" do not apply literally. They should read, "keeps up." A heavy machine cannot go up instantly on account of its inertia, but it can as instantly increase its lift as it can turn on full power and put its surfaces at a steeper angle. To steer down in order to keep up was relatively a *slow proceeding*, because even with the aid of gravity inertia cannot instantly be overcome. But with reserve power there is no need to overcome inertia, and the remedy can be applied at once.

With these explanations in mind, we understand why Europeans speak as they do of some dead officer who "lost his life because he attempted to imitate champions on high-powered machines with a weak machine."

The Germans had drawn somewhat too hasty conclusions as to the best type of a military aeroplane and had standardized it. The French simply enlisted all their current sporting types for army use, types which were inferior in long-range scouting, demanding, as it does, only reliability and sturdiness in normal flight, for which the Germans had provided at the war's beginning. But the French machines were better for aerial fighting, which has about as much to do with steady, normal flying as a free-for-all fight with walking in a procession. The new art of flying had to be learned in aerial duels, just as a boy is taught to swim by the simple process of throwing him overboard.

Maximum strength, minimum weight and least head-resistance are best attained by the aeroplane that has its propeller in front of a boat-body. But the propeller in front impedes observation. It also interferes with the operation of a machine-gun. Biplanes, such as this one, have been designed with the object of overcoming these military objections



This British military aeroplane is of the latest type. And yet how similar it is to the crude, early machines of 1908. There are only two striking outward signs of improvement: the streamline boat-body enclosing everything and minimizing head resistance, and the solid inflexible appearance of the wings, due to the invention of enamels which strengthen and shrink the cloth covering and make it as smooth on both sides as Japanese lacquer

Daily encounters in the sky prove conclusively enough that flying has been as thoroughly mastered as horseback riding. In neither can any attention be paid to handling the machine. There are too many other very important matters to think about. The machine must respond to any subconscious action of its rider as obediently as a cavalry horse, so that its guidance becomes as much a matter of subconscious action as that of a warhorse. Accounts of air-duels read, in fact, as though fighting aeroplanes were under better control than cavalry horses. To place a shot at close range in these wild swoops, without being hit, can be compared only with fighting a saber-duel while jumping hurdles. The fastest French and British machines were found to be the most formidable fighters. Hence they were imitated (and fatally bettered) by the Germans and Austrians.

And Yet, the Aeroplane Is Unchanged

It is surprising how little the general appearance of the aeroplane has changed during its entire history, in spite of its marvelous development. Only the automatically stable types, distinguished by their backwardly-turned wings and upturned tips are an exception. But the aeroplane is such a simple device (and has been found best in its simplest forms) that the phenomenon is easily explained. There are only two striking outward signs of improvement: the streamline boat-body, enclosing everything and minimizing head-resistance, and the solid, inflexible appearance of the wings, due to the invention of enamels which strengthen and shrink the cloth covering and make it as smooth on both sides as Japanese lacquer.

Maximum strength, minimum weight and least head-resistance are best

Before the war, only two or three machines in an endurance contest, in which perhaps twenty aeroplanes were entered, reached their destination. But now we hear of flocks of fifteen flying from Calais to Karlsruhe on a bomb-dropping expedition and returning safely. Surely the war has taught us much about flying machine construction

attained by the aeroplane that has its propeller in front of a boat-body. Thanks to the tractor-screw the biplane has developed as much speed as the monoplane. It is even preferred, since its greater surface gives more lift in emergencies. Unobstructed vision in front is often so desirable that the propeller is sometimes placed behind the surfaces and the boat-body shortened, in spite of the increased head-resistance and decreased strength of the design with the rudders carried by poles. A beautiful solution of the problem of free vision is obtained in large passenger-carrying machines, with the long bodies of which rudders are integrally combined, two tractor-screws and two separate motors being mounted on both sides of the main body. It is then essential to enclose the motors in separate bodies. In the big German battleplanes, the motor bodies are long and carry the rudders. Even such designs waste a certain amount of power, because a catamaran has always less speed than a single boat. But multiple bodies and division of load across the span of the planes is the only method by which large aeroplanes are enabled to carry many passengers and to exhibit that strength which it has taxed all the ingenuity of the scientific engineer to obtain even in the smaller machine.

Has the Big Aeroplane Come to Stay?

Mammoth aeroplanes are at present a spectacular development, especially in America. But it would be premature to include them in a seriously critical review of the aeroplane of to-day. In the main, they have not yet justified themselves, although some of the big water machines of Curtiss, are said to be in frequent use. But there are no accounts of their performances under very critical air conditions, when their relative lack of strength would be a very serious matter, judging from the experiences of similar smaller machines. What recommended them is not economy of performance (because they carry relatively less per square foot of surface than smaller water machines) but the improved facilities offered for navigation, comfort for long trips, and the advantage that one pilot can transport many passengers. They are also required, whenever a great radius of action is demanded, which can be obtained with aeroplanes only by cutting down the passenger list and carrying more fuel instead. In a small machine, this would mean amputating the alighting gear.

The difficulty of starting and alighting with a mammoth plane is serious. The impact of the heavy mass is too much for its strength, especially for the landing wheels, which have to be made very bulky and clumsy, consequently wasting power in air-resistance. Transformed into a flying boat the mammoth machine becomes more practical, because the hull partakes of all the naval advantages that follow with increased size. Strains to which they are subject from gusts must be formidable. But no technical accounts of their behavior in the air have been published.

Air-fighting is fully as romantic as ever were the deeds of Homer's heroes or Cooper's Indians; for this is the day of personal prowess in air-fighting. We need not dwell solely on the exploits of such German supermen as Immelmann and Boelke (each with a record of at least fifteen victories). Neither superiority of numbers nor of machines cuts much of a figure if it is matched against a certain mysterious personal equation, which cannot as yet be completely analyzed. It may be safe to say that rapid, masterful marksmanship plays in it no small part. It would be indeed a rare coincidence if this ability were likewise found combined with exceptional talents (like Pégoud's) for managing an aeroplane. If that be the case it is obvious that a fighter and flyer in one person must be more formidable than the co-operation of a mere flyer and a mere fighter. We need only imagine two cavalrymen on the same horse (assuming that they could be accommodated together as perfectly as two flyers on a machine) of whom one wields only the lance and the other manipulates the bridle. How should they communicate their respective intentions in fractions of a second?

But this holds good only in regard to small powerful racing machines which fight wasp-like at close range.

Crossing Dangerous Rivers with Goatskin Floats

The inflated goat skins are used by the natives either as life-buoys or as river-horses

THIS is not, as might be supposed, a photograph of a man with his performing seal climbing over his shoulder, but only a picture of a Kashmiri with his goatskin swimming-skin.

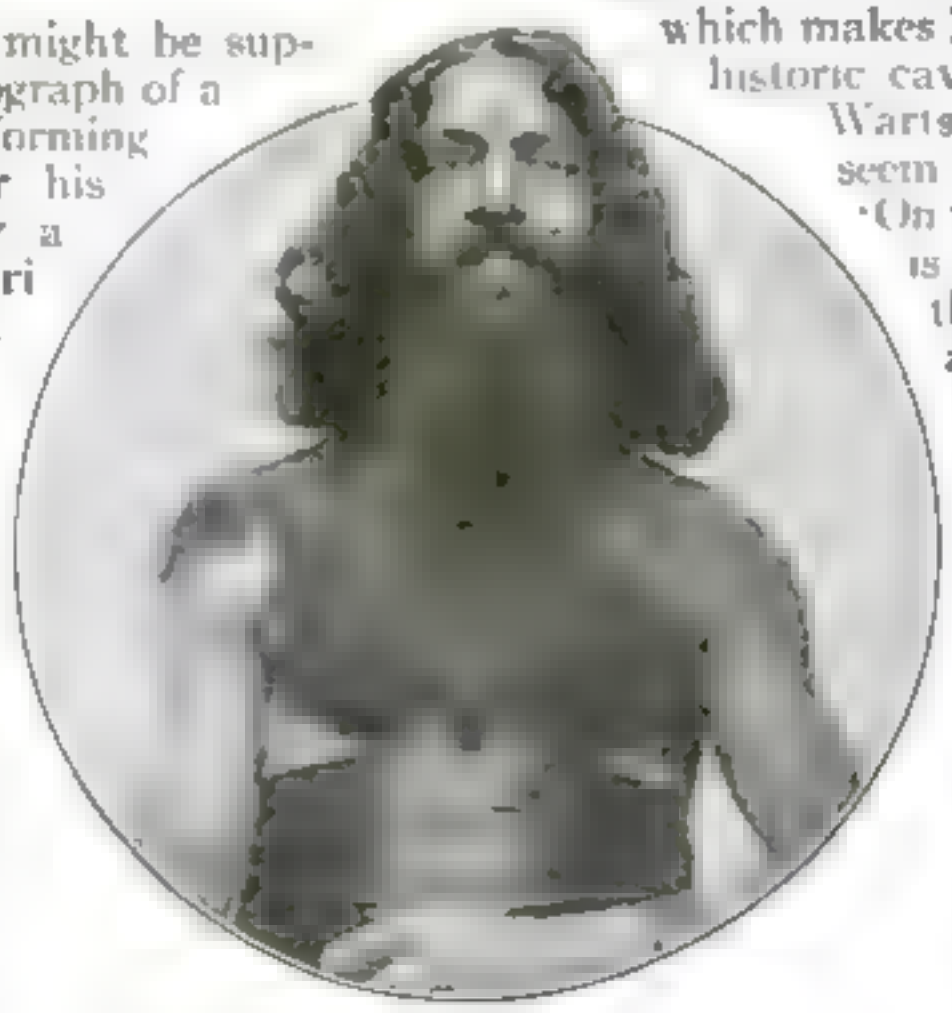
The skin to be used for this purpose is taken off with as little cutting as possible, after which the hair is removed and the hide softly tanned by hours of patient scraping. Then the feet and neck openings are coated with pitch—tree balsam is used in the Himalayas and asphaltum in Mesopotamia—and sewn up so closely as to be impervious to the water. A small hole—usually at the nose—is left for inflation, and this is afterwards closed by folding over and tying with a thong.

The inflated skins are used in several ways, the simplest and most common one being as a support for the body while the vigorously kicked legs propel it across a river. In fairly smooth slow-flowing streams a paddle like the one shown in the photograph is often employed, the paddler in such instances riding his buoy like a horse. In fording the swift mountain torrents that flow into the upper Indus, a much smaller skin than that shown in the illustration is employed. The swimmer sprawls over this and uses both arms and legs as combination propellers, steering gear and buffers against the ever imminent rocks.

Where Beautiful Hair Is Not a Crowning Glory

THE man in the accompanying photograph, who is shown in his perpetual furs of human hair, is a striking illustration of what medical science calls a case of hypertrichosis, or excessive growth of hair on the human body. This man not only has locks which are the envy of chorus girls, but he has a beard and below it a hairy mat which makes him look like a prehistoric cave-dweller.

Warts and too much hair seem to go hand in hand. On the other hand, there is no truth in the theory prevalent that abundance of hair saps one's strength, or that it signifies a great reserve of strength. People who are excessively hairy, such as the man shown, are perfectly normal except for their uncomfortable hairiness. They are not necessarily weaker or stronger than the rest of us.



The hair of the head and beard is soft and beautiful. The rest is short and furry

The Motorcycle Machine-Gun

Above, our motorcycle company patroling in Mexico
Below, the motorcycle machine-gun car. The gun carriage can be detached or replaced in thirty seconds

WILL the motorcycle supplant the cavalry horse in modern warfare? Our army officers are not ready to give an answer one way or the other at present, but since March 30, 1916, up to which time the motorcycle had been used only for messenger service in the United States Army, Brigadier-General George Bell, Jr., had been testing the armored machine-gun car to determine whether it may not eventually supplant the cavalry horse.

After exhaustive tests over every conceivable sort of road, including no road at all, the sidecar attachments were adopted. Single machines carrying two men were found to be useless in deep sand or mud. With sidecars carrying three men in all, all manner of roads were used. At the present time a motorcycle company is patroling the one hundred and thirty miles of Mexican border between Laska, Texas, and Noria, New Mexico.

Compared with cavalry troop movements the motorcycle has done things which seem almost incredible. On Memorial Day a report was received at Fort Bliss of a bandit raid fifty-four miles down the border. Exactly two hours later the motor cycle company, with each machine carrying three soldiers, was on the spot where the raid was reported to have occurred.

A few weeks later a raid was reported at Canutillo, eighteen miles from Fort Bliss. The motor cycle company reached this place, ready for action, thirty minutes after the order was received. The first trip would have taken a troop of cavalry two days, and the second four hours to make.

It is said that a machine-gun car and two men are equal to fully one thousand riflemen. Because of its speed army officers are looking upon it with favor.

Hunting the Mud Pigeon

By Edward C. Crossman

A squad moving up. The three men in the rear have fired and are moving. When the first man has fired at five clay birds he will walk around the squad to the first position

FIVE strong men stood in a row, armed with guns and evidently much interested in something that was going to happen in the little house out in front of them. There was not much to the little house. It stood possibly a foot and a half high at the back end, toward the shooters, and six inches higher at the front. Six feet would span its length, four feet its width. It wasn't much more than a good substantial cover to the entrance to a cylone-cellar.

The strong man on the right end of the line raised his shotgun and pointed it apparently at the top of the little house. He snuggled his face to the stock, then he barked something that sounded like "Pull," and from the shelter of the little house, fleeing straight away from the line of men there sped a little black and yellow saucer. It rose as it traveled, and in the wink of an eye it was far higher than our heads and farther from the little house than the distance to the row of men.

Then the gun cracked, and the fleeing disk suddenly flew into a cloud of black bits. They say it takes shot a little time to cover a distance, but the black and yellow saucer smashed up almost before the gun barked.

The next man repeated the performance, only the little saucer came out from a different direction, sneaking off swiftly to the right and away from the line, but not so swiftly that the shot didn't catch up with it and end its career. The third sneaked out the opposite way, to the left, and it sped on, unharmed in spite of the crack of the gun. The man grinned a bit and shook his head, but nobody spoke. So the shoot went on until finally we began to look at the machinery that made the saucers hiss so swiftly out of the house at the word of command.

How the Clay Birds are Launched

A few yards back of the center man of the row there stood a boy with an iron lever in his grasp. The upper end reached to his waist, the lower end disappeared in the ground. From our

feet as we crossed the line between him and the little house there came a queer rattling of hidden machinery. This was the "puller," and with the lever he set and sprung a throwing-machine out in the little house, like the old time instruments of war with which the ancients used to throw rocks, fireballs and other pleasantries into the cities of the other fellows.

In the little house when the squad had finished shooting, we found the machine, the trap as it is called, merely an inclined steel plate with a throwing-arm faced with rubber and impelled by a powerful, coiled spring. Inside the house sat another boy, the trapper. He set a little clay saucer, bottom-side up on the steel plate; the puller gave the lever a little twitch, releasing the trigger holding the arm, and it swept swiftly across the plate, hurling the saucer out ahead of it and giving it a rapid whirling motion as it flew. Then with the lever and a long rod reaching to the traphouse, the puller hauled the steel arm back to the set position, and the trapper placed another "bird" in position to be thrown.

Another form of trap holds the bird in a pair of steel fingers at the end of the throwing-arm, and this is almost human in its resemblance to the pair of fingers and the arm of the small boy, with which he takes the flat bit of slate and "sails" it edgewise through the air.

The saucer, or "clay bird," is made of river silt and tar—just plain mud, as a matter of fact, baked after being formed into moulds. It is four and one-quarter inches across, and about an inch from bottom to rim. The rim is very heavy, to stand the strain of trapping; the top very thin and light. The whole "bird" is quite brittle, and usually departs this life when hit by even a single tiny pellet of No. 8 or 7½ shot.

The Rules that Govern Trapshooting

The rules of the game are that the shooters, five of them to the squad, shall stand normally sixteen yards back of the throwing arm of the trap, and three yards from one another, as marked by the row of little pegs set at the sixteen-yard mark from the house. The birds thrown from the trap shall fly at unknown angles; that is, the shooter does not know in which direction the bird will fly from the trap, which is changed in direction by the trapper in the house. But the limits of the flight are also fixed by the rules, which are that the trap shall not throw its birds higher than twelve feet nor lower than six feet at a point thirty feet in front of the little house, nor at angles greater than forty-five degrees to the right or left of the straight line from the puller down through the house and out along the grounds.

Save in a wind, the birds from a certain trap fly at the same height from shot to shot, the elevation not being changed; but they change their direction each shot. Because the shooters stand nine feet apart, and the first and last man in the line are therefore eighteen feet to the right and left of the center of the trap,

The scorer. A black "I" mark means broken or killed birds. To score the bird "dead," the shooter must break off a perceptible piece. A puff of dust will not do

In this method of shooting the man with the machine simply pulls the trigger and the clay bird soars in the air

it follows that if the man at the extreme left end of the line, who is No. 1, gets a bird leaving the trap at the extreme left angle permitted, he gets a bird that is swiftly traveling right across his line of fire seemingly.

This is termed a quarterer. If the bird, on the other hand, flew straight away from No. 3 man, who stands back of the very center of the trap, it would be a straightaway from the trap and from this man, but still quartering to the line of the others in the squad. Quarterers are the bane of the beginner, because he shoots right at them, and they are not there when the shot arrives, but much farther to the right or left.

In trapshooting the rules forbid guns larger in bore than 12, and charges of shot heavier than one and a quarter ounces. Black powder, because of its smoke and interference with the vision of the shooters and scorers, also is taboo. Because the shooter likes to shoot as many pellets as he can and still cannot shoot too small-sized shot, lest they fail to break the bird, he has found that No. 7½ or 8 shot is the happy medium between shot too small to break the clay, and too large to make a dense cloud or "pattern" of shot through which the little clay cannot escape. Usually the powder load is three drams of smokeless. The guns must weigh from seven and a half pounds to nine to absorb kick and make shooting pleasant, but this is not a rule of the game, merely common sense.

How the "Events" are Conducted

In a regular shoot, the shooters are divided up into squads of five, who remain together through the day or the whole tournament unless handicap events which require different distances for different shooters make re-squadding necessary. Each "event" may consist of from fifteen to twenty-five birds, each man firing at this number, then retiring with the squad in favor of the next set. To make the game fair and give every man his trial at a different peg and so a different angle to the trap, the whole squad moves up one peg when a fifth of the event is shot. In the 25-bird event when No. 1 has shot down five birds he moves up to No. 2 peg, and so on down the line to No. 5 man, who takes his gun and doll rags and walks down behind the length of the squad to the vacated No. 1 peg. After the next five birds there is another move, and so on.

Each shooter fires in turn, raising his gun and getting it in the correct position the instant the man to his left fires. The rules permit the shooter to raise the gun to the shoulder and get all settled before calling for the bird, which he does with the never-varying word "Pull!" The instant the puller hears the word, the bird is sped from the trap. The slightest hesitation in the act of the puller will effectually "balk" the shooter,

so accustomed is he to the dash of the bird on his call, and the more experienced the shooter, the more likely is this to cause him to miss.

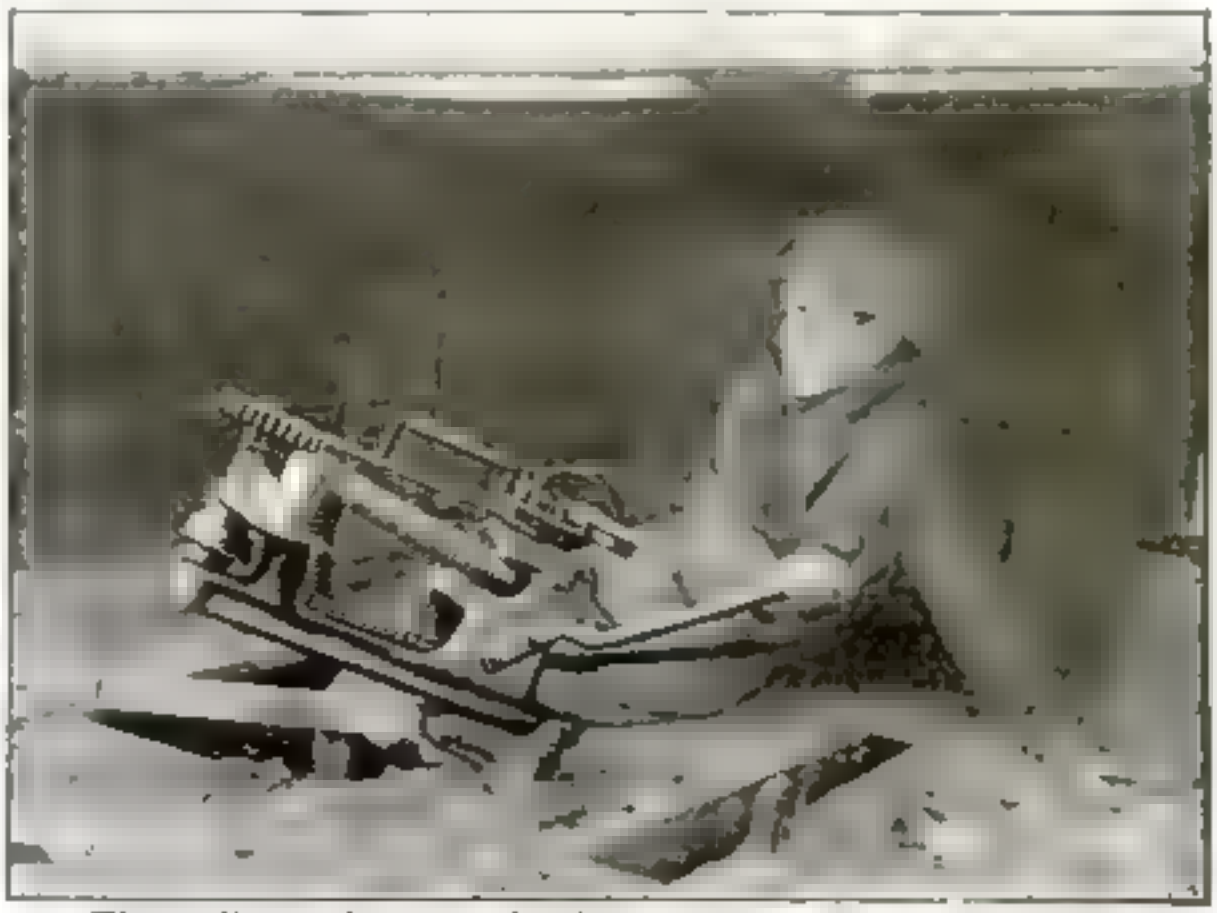
To score the bird "dead" on the score sheet, the shooter must break off a perceptible piece. A puff of dust will not do. Many and many are the peeved shooters who see the fatal plume of dust rise from the bird, but do not get it scored to them. That means that a single pellet of shot has passed through the top of the bird, but due to the inaccuracy of the shooter's pointing, the pellet hit but the outside of the shot circle, and he has virtually and legally missed the bird.

As the shooter cannot stand nearer than sixteen yards to the trap, and in handicap events, may be put back to twenty-three yards, it follows that the bird because of its high speed, gets another sixteen yards or so from the trap before it is hit. Probably the average shooter hits his birds at about thirty-five yards from the muzzle of his gun. Here there is a circle of about thirty inches of shot, which, placed on the bird, will surely break it. So the problem of the trapshooter is to judge the speed and angle of the bird so that he can place a two and a half foot circle of little pellets in the path of the saucer. He may have to pull the trigger when the muzzle is three feet ahead of a quartering bird if he is a slow shot and a slow swinger to hit that saucer.

Because of the danger of the small saucer getting through the hissing cloud of pellets without being hit, full choke guns, which hold their charges together and shoot dense clouds, are necessary for the trapshooter, and even then there are times when the slow shot, firing when the bird has gotten so far away that the cloud of pellets has spread widely and thinned out, misses merely because his "pattern had a hole in it."

Trapshooting is a game in which the gun and the clay bird are the tools as the ball and bat are in baseball. It is not preparation for any other shooting any more than baseball is preparation for anything else. From the little houses covering the pits in which are set the trappers and traps and birds, there speed more than thirty-five million of the little saucers each year. Forty-five hundred clubs follow the game of the trap. Four hundred thousand men shoot once or more each year at the clay birds.

While the beginner marvels at the immensity of the space surrounding the little birds, and the shortness of the time available in which to locate the flying saucer and judge its angle of flight, put the gun on the right spot and pull the trigger, yet the skill acquired by the shooter following the game is wonderful. Breaking ninety of the clay birds out of one hundred in a big tournament would not put one within the first ten per cent of the men entered in the shoot unless the conditions were unusually bad. There are hundreds of instances where a hundred of the birds have been broken without a miss, while a professional shot has the record of more than five hundred straight hits. The record for 1915 was three hundred and seventy-two in competition, without a miss, four hundred and ninety-nine out of five hundred by the same man.



The puller reclining in his little house. He watches each clay bird as it leaves the machine and he knows that his slightest hesitation will "balk" the best shooter

Eliminating One of the Tortures of the Dentist's Chair

By pressing three buttons located at the back of the chair, water of three given temperatures may be immediately obtained

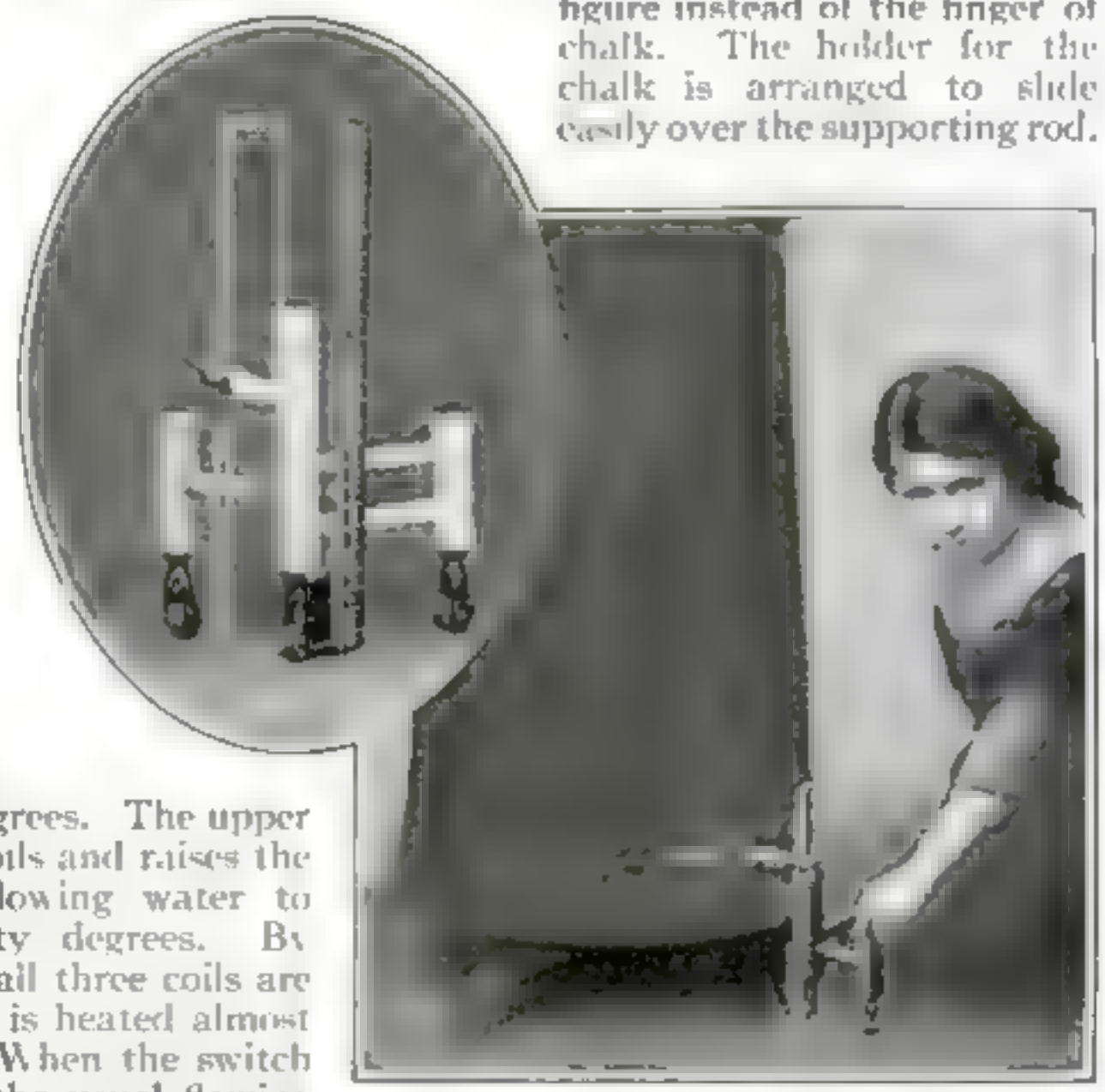
COLD water on sensitive teeth as you sit writhing in the dentist's chair is the height of discomfort. No longer need the dentist submit you to this inhumane treatment if he uses the apparatus illustrated. An improvised form of water-heater enables him to have at his side at all times water of three fixed heats. All he has to do is to press two buttons to obtain water at the desired temperature.

The apparatus is fitted to the water fountain and three separate electric coils do the heating. The switch-control hangs on the back of the chair. By pressing one button the corresponding coil is thrown into the circuit to heat the flowing water to the steady temperature of one hundred degrees. The upper button connects two coils and raises the temperature of the flowing water to one hundred and fifty degrees. By pressing both buttons all three coils are utilized and the water is heated almost to the boiling point. When the switch is off the water is of the usual flowing temperature well known to the patients.

It Was a Man Dressmaker Who Invented This

AN ingenious German has invented a device for accurately chalking off the length that a fashionable skirt should have. He has built a triangular frame on rollers. Attached to the frame in front is a wire-support. A piece of chalk can be fixed in the support at the right height by means of a thumb-screw, the height being accurately gaged by means of a vertical ruler attached to one of the legs of the roller-frame.

The skirt to be measured is hung on a dressmaker's lay figure, and the apparatus is so placed in front of it that the lower part of the skirt comes into direct contact with the chalk while hanging between the scale-rod and the wire frame. The frame and rod support the skirt and prevent it from slipping away under the pressure of the chalk. This makes it possible to get a clear chalk mark all the way around. Since the apparatus runs on rollers it is easily moved around the skirt, which is a decided advantage over the old way of revolving the lay-figure instead of the finger of chalk. The holder for the chalk is arranged to slide easily over the supporting rod.



The marker grasps the skirt and secures a firm surface upon which to make its line

Preserving the Orchestra Leader's Art

THE special talents possessed by celebrated orchestra leaders are to be immortalized. What is more, it now becomes possible for the same leader to direct hundreds of bands at once from a motion-picture screen.

An orchestra leader must be photographed both as he appears to his musicians and to his audience—in other words, he must be photographed in front and in back. He takes his place, as shown in the accompanying illustration, between two cameras, which are concealed by partitions so as not to be included in the picture. Camera 1 takes the front and camera 2 the back view, while the conductor is beating time. But in each case the image covers only half the film. One-half negative registers the front views and the other half the back views.

The two films are cut in half and joined, so that we now have a single film which carries the two sets of pictures, and which can be used in a moving-picture projector with certain modifications, as shown in our illustration.

A screen is employed, the upper half of which is transparent, the lower half opaque. The set of pictures showing the front view is thrown on to the lower opaque half which lies in front of the musicians, so that they see the leader just as he would appear when really conducting the orchestra. This is all that would be absolutely necessary as far as the musicians are concerned. But at a concert the effect is much better when the audience can see the leader as well. The second or back view comes into use here. The back view of the conductor is thrown on to the upper transparent screen, so that the audience seems to see the leader as usual. A partition prevents the musicians from seeing the upper half of the screen.

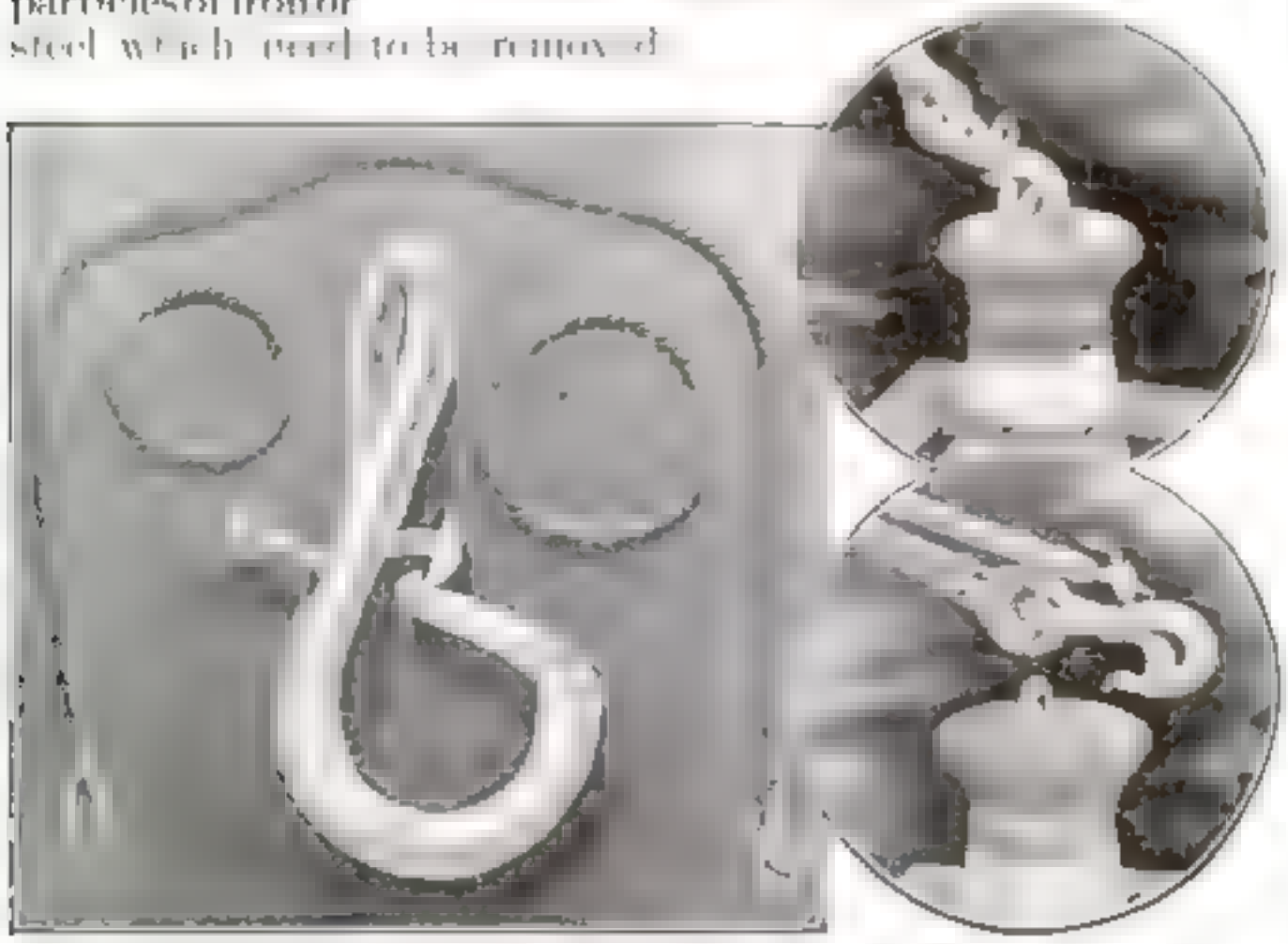
At the upper left the two concealed cameras are shown. Each takes but half a negative, the halves being pieced together as in the lower left picture. A screen having a transparent portion for the audience to see and an opaque portion for the musicians alone, is employed

A Hand-Magnet That Lifts Fifteen Times Its Own Weight

A SEVEN-POUND hand-magnet which is capable of lifting castings of from ten to fifteen times its own weight fills a long felt want in machine shops where it is used for clearing chips and borings out of the machinery. This is only one of its many uses however, since it recovers dropped tools, bolts, and boring bars which could not be easily recovered from awkward places.

Where large quantities of brass and iron filings accumulate, the magnet is used to separate the brass from the iron. The magnet is used to pick up hot or awkwardly-shapedcastings and can also be suspended in liquids such as paints, glazes and chemicals to attract to itself any particles of iron or steel which need to be removed

Where large quantities of brass and iron filings accumulate this magnet will be found invaluable for separating them



Mooring-Hook Locks Itself to Eyebolt

THE harder the boat moored on the new self-locking mooring-hook pictured below pulls, the less chance there is for the boat to get loose. In use it is merely necessary to toss the hook into the eyebolt on the dock or buoy and the yacht is fast, since it automatically locks, although there are no springs in the device. To loosen it a poke of the boat-hook is sufficient.

The lock is composed of an ordinary hook, to the tip of which is attached a lever, which catches a piece of steel in the shank of the hook much as a door-latch is caught. It cannot be loosened unless the upper end of the catch is pushed forward. This is accomplished by a thrust of the fingers or of a boat-hook in the opposite direction, from that in which the boat itself is pulling.

All pulls on the line itself are taken up by the hook. Should the line be twisted, so as to pull in the opposite direction, the pull is taken up by the lever which is caught and held.

The harder the boat pulls on the hook the less chance it has of breaking loose from this type of mooring

Holding the Hudson at Bay

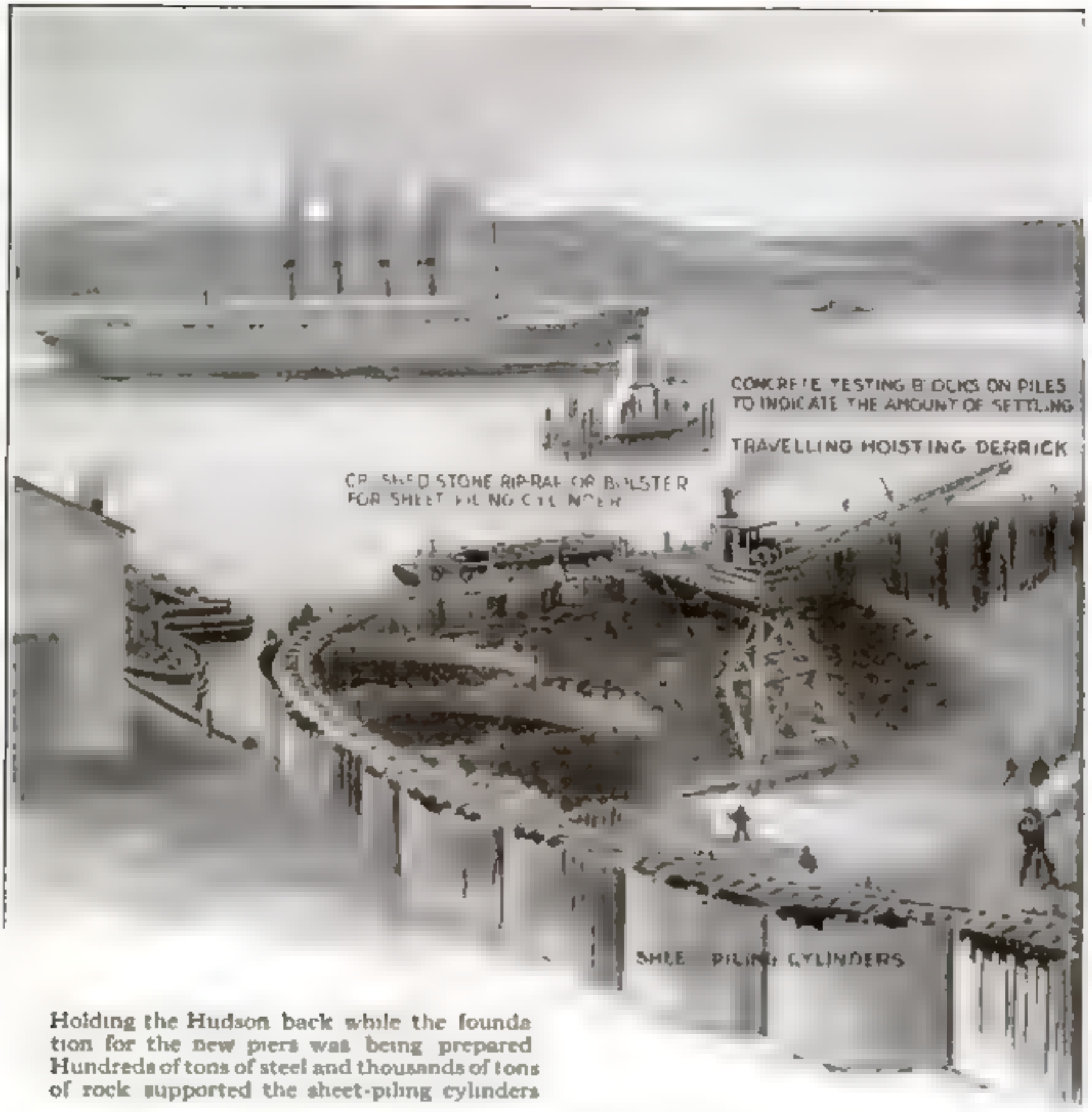
When the project is completed New York will have piers large enough to enable the world's largest ocean-liners to dock in a few minutes instead of several hours

TO make way for the giant steamship piers which when finished will enable the world's largest ocean-liners to dock within a few minutes, instead of a few hours, which is now the case, the City of New York, through its Department of Docks and Ferries has constructed a cofferdam which holds sixty-eight feet of the Hudson River at bay while workmen are clearing out rock from the river-bottom and laying the shore-ends of the piers.

The engineering world was much interested in the raising of the battleship Maine in Havana Harbor, where a head of water thirty-seven feet deep had to be reckoned with, but interest has now shifted to New York. At Havana the cofferdam was elliptical and the rounded ends helped to reinforce the sides. In New York the wall holding back the waters is L-shaped, eight hundred feet long on one side and three hundred feet on the other.

Interlocking sheet steel-piling was used to form the backbone of the cofferdam, and this was driven so as to make a succession of contiguous pockets approximately sixteen feet in width and twenty-four feet in length. These pockets were filled with material dredged from the river-bottom, and as it settled it turned the pockets into steel-clad pillars of earth. The steel piles were driven down to the underlying bed-rock which dipped riverward. But this was not a sufficient guaranty of rigidness. The object of shutting out the river was to enable hundreds of workmen, with pneumatic drills, to get at the rock normally below the tide so that it could be blasted away smoothly, and structural work reared upon the resultant clean ledge. This structural work is eventually to support long piers for the accommodation of liners one thousand feet in length.

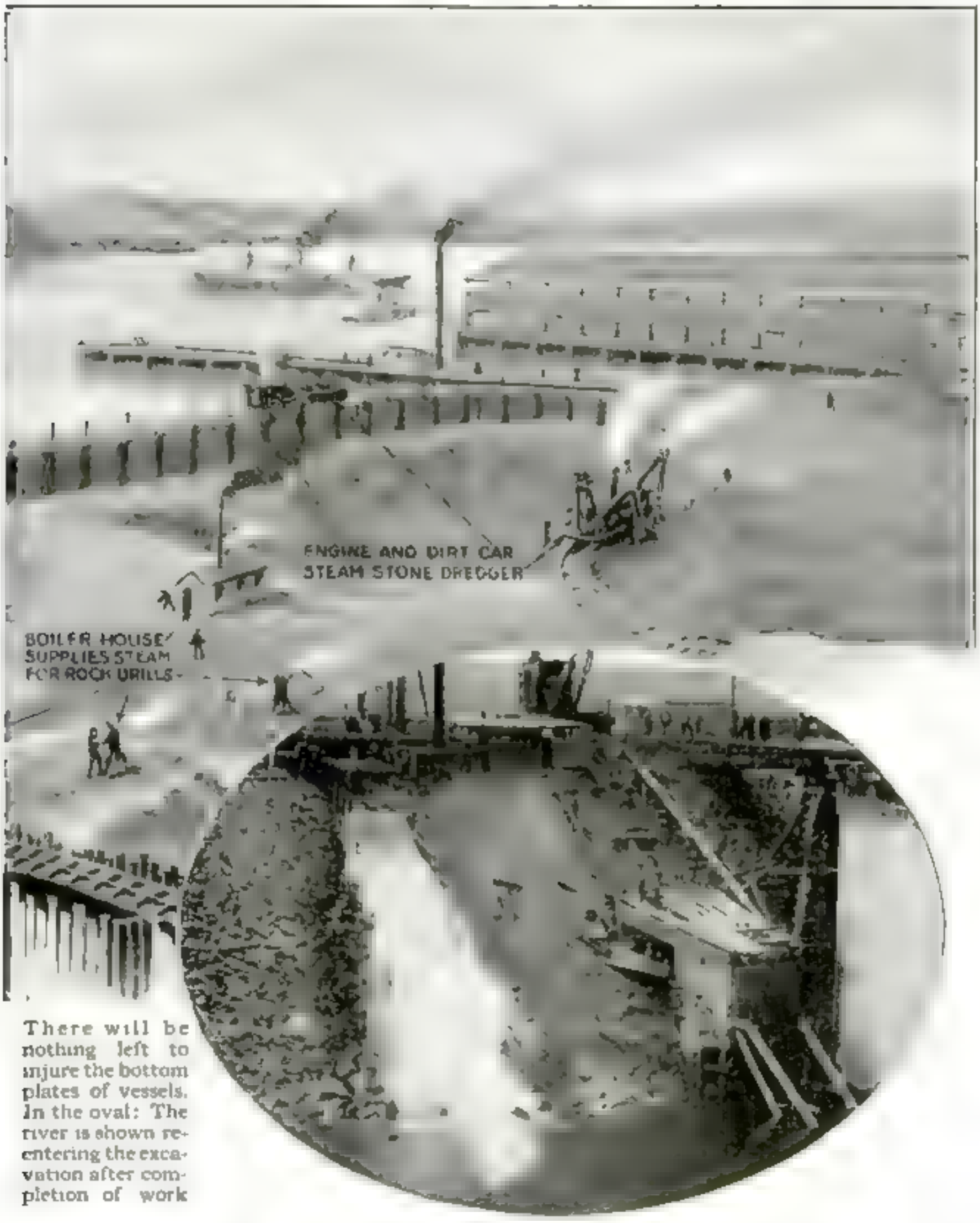
To guard against any possible collapse it was decided to build a slanting rip-rap bank inside the cofferdam, and stone was piled up until the base of the dam had a width of seventy feet. But there was a point where this rip-rap could not be built; it was at the corner where the inshore end of the cofferdam joined the main body of the bulkhead. There the engineers had to have the rock uncovered



Holding the Hudson back while the foundation for the new piers was being prepared Hundreds of tons of steel and thousands of tons of rock supported the sheet-piling cylinders

so that the drilling and blasting could be carried out close to the steel-sheet piling. To obtain the necessary rigidity, the smaller pockets were replaced by two great circular units fifty-five feet in diameter. These were filled with broken rock, which made them stable. The pressure developed in the cylinders made them watertight.

Along the stretch of cribbing a single line of interlocking steel-sheet pilings had been driven. When leakage occurred at that point it was suggested that the crevices be plugged by means of fluid cement or "grouting." The heavy expense of this remedy caused hesitation, and resort was made to another expedient, this latter proving an effective and cheap way of halting the water. To begin with, a timber pile twelve inches in diameter was driven down into the space back of the old cribbing, and then withdrawn, leaving a hole. This cavity was filled with a wadding composed of successive layers of earth, sawdust and manure, driven down hard by the pile which served the double purpose of ramrod and plug. In this fashion, a row of wooden pilings and an equal number of water-tight wads were driven deep into the underlying earth, proving amply sufficient to stop all leaks. A little seepage, however, came up from the bare river bed, but a small pump was sufficient to handle it. At Havana, pumps had to work constantly, and at



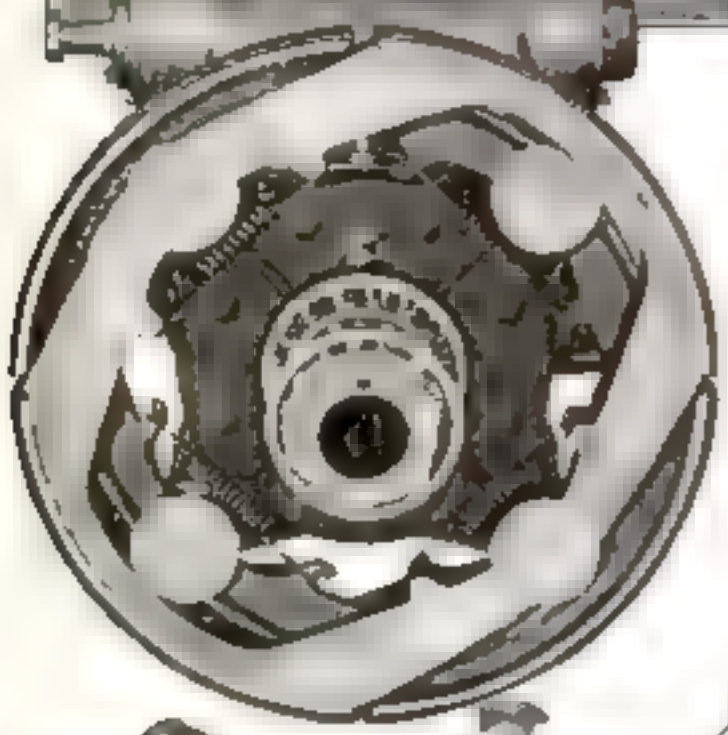
There will be nothing left to injure the bottom plates of vessels. In the oval: The river is shown re-entering the excavation after completion of work

the Black Rock Dam, near Buffalo, it was necessary to have three fifteen-inch wrecking pumps in continual operation.

To-day the drained area on the east side of the Hudson is noisy with an incessant chorus of drills, with the occasional counterpoint of a heavy blast. When the carving of the slips or waterways is completed, there will be no obstructions to injure the bottom plates of vessels floating there. The piers will be one thousand and fifty feet in length, and one hundred and fifty feet in width.

One interesting feature about the piers is that only a small part of their length will be supported by actual contact with the underlying rock. The remainder will float, and the anchorage will be the grip which the piles have on the semi-fluid mud of the river bottom.

Some New Ideas Which Automobilists Are Employing

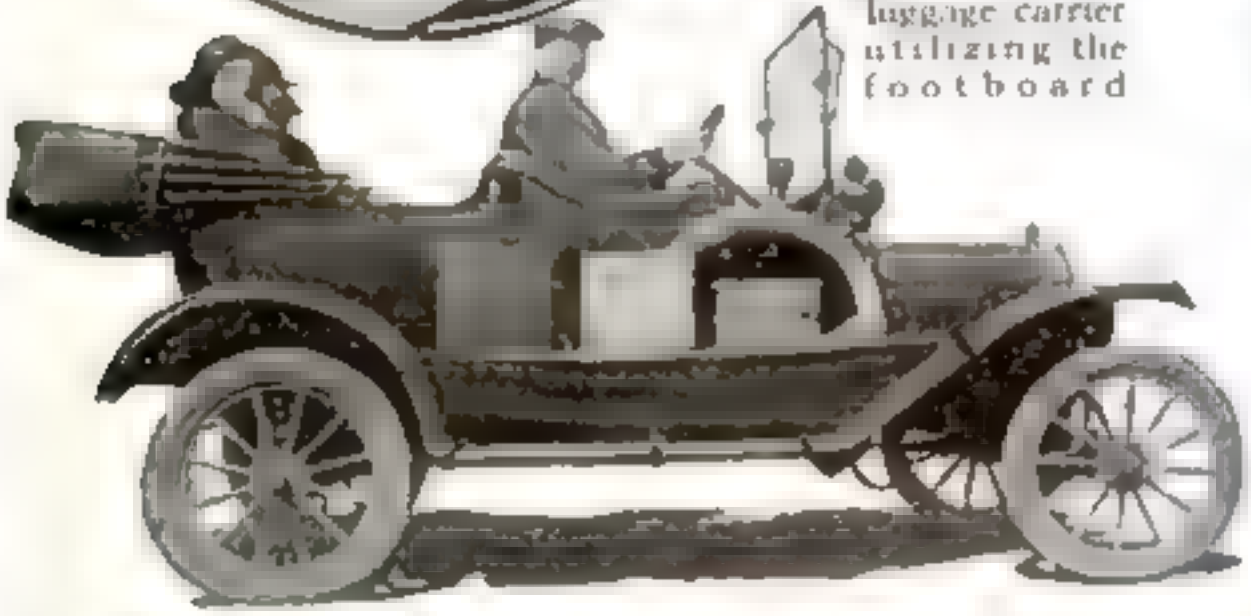


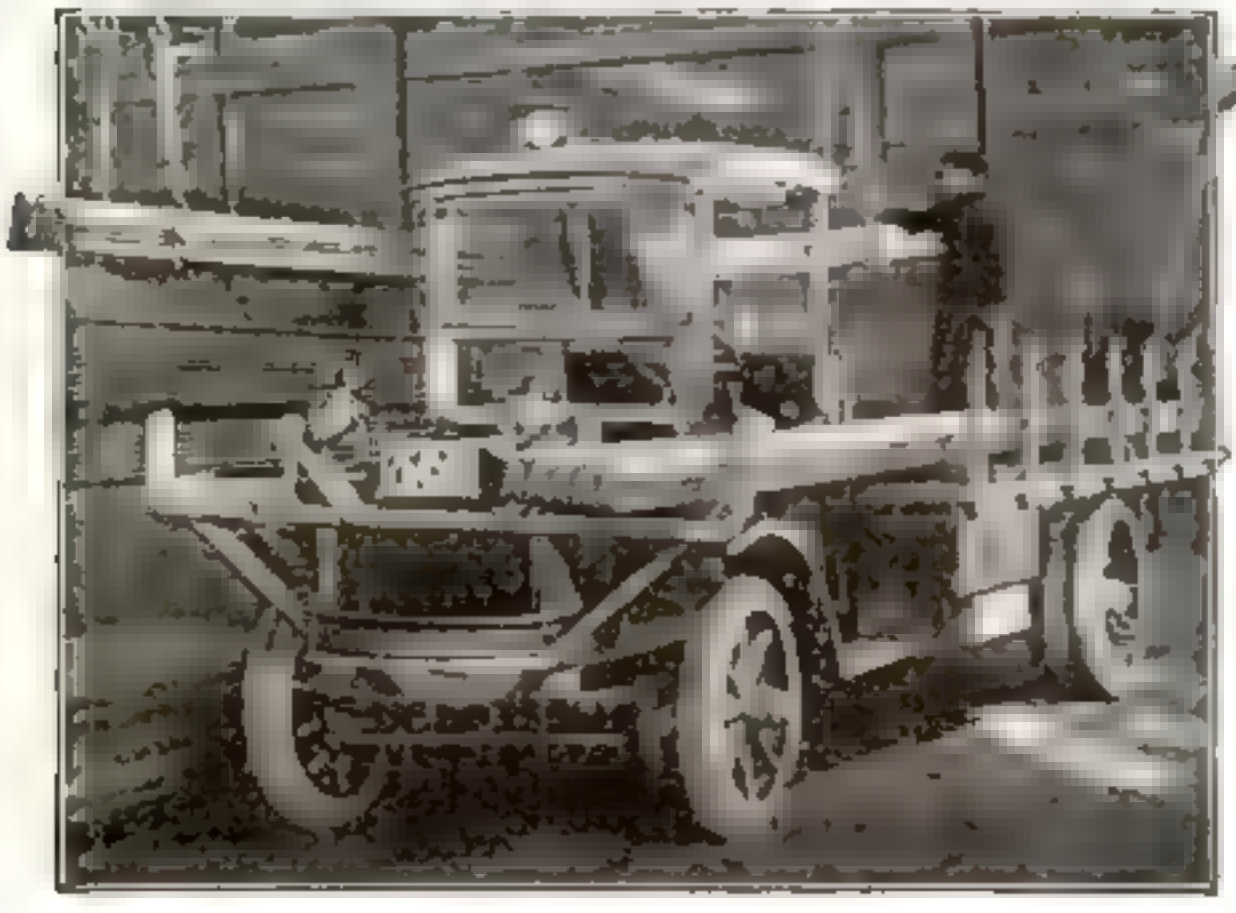
Above, automobile tops of leather substitute tested for a year in an open field

At left, a five ton worm-driven motor-truck axle which has a pressed steel housing

Below, a new automobile luggage carrier utilizing the footboard

Above, a special apparatus of long beams on tires designed to aid in towing disabled cars

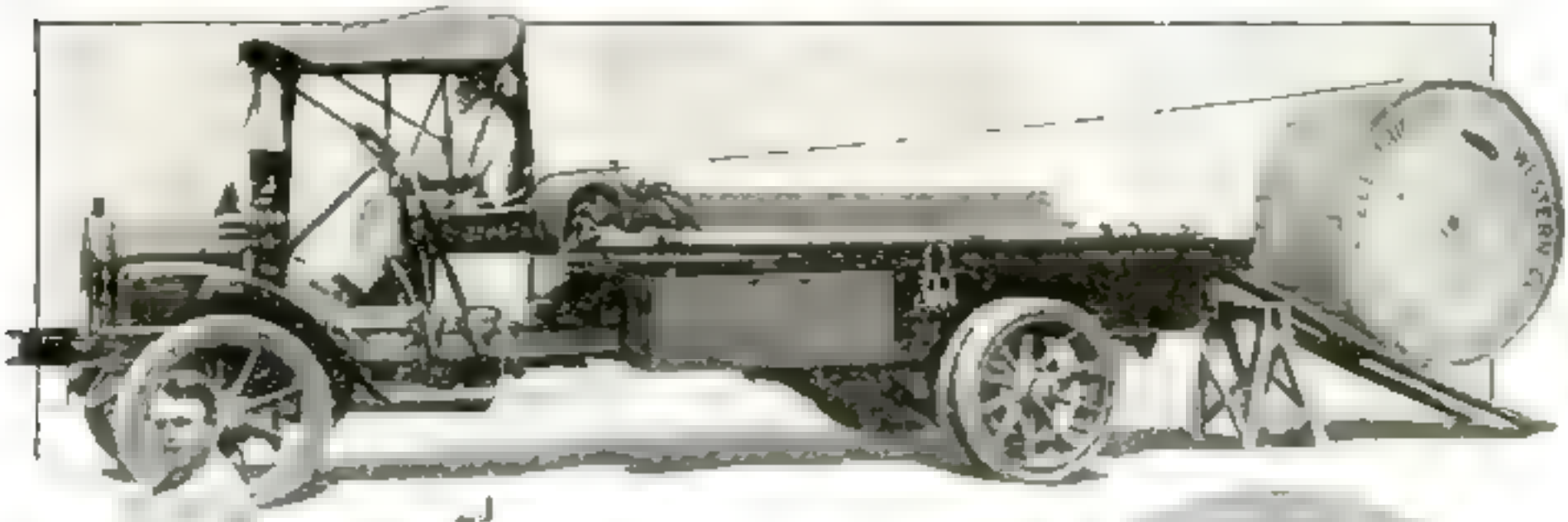


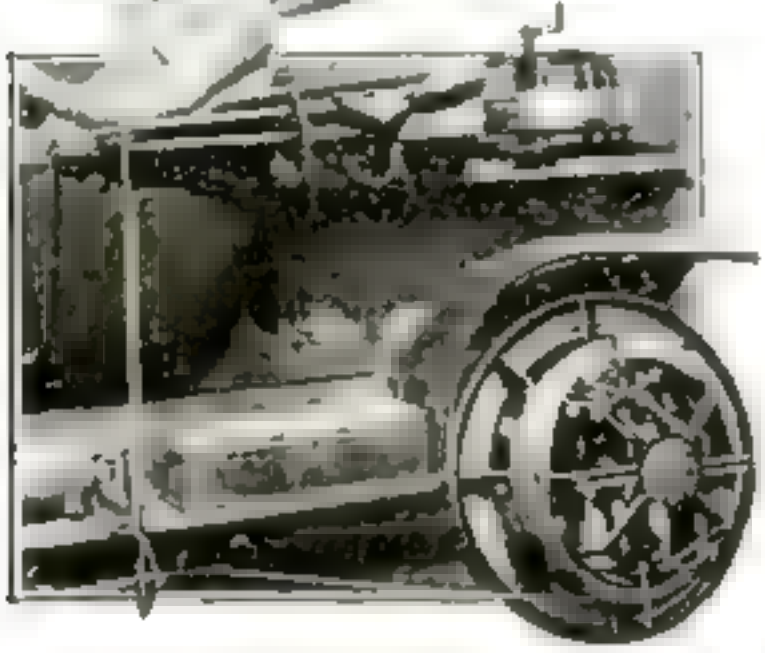


Above: Four jointed steel arms raise this steel coal body ten feet in thirty seconds

At left: A narrow driver's cab and two steel U-shaped supports front and back enable this truck to carry twenty-foot steel beams

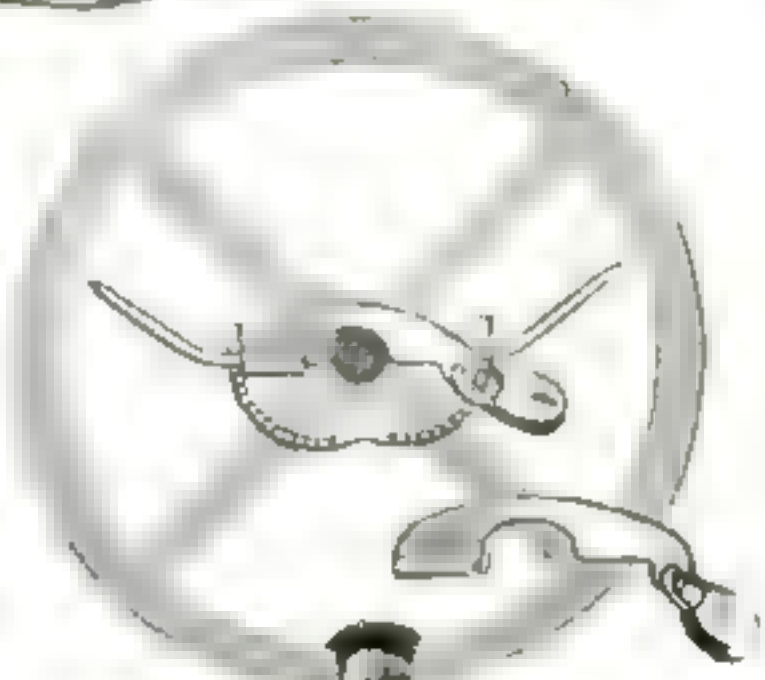
to Make of the Motor-Truck a Mechanical Day Laborer





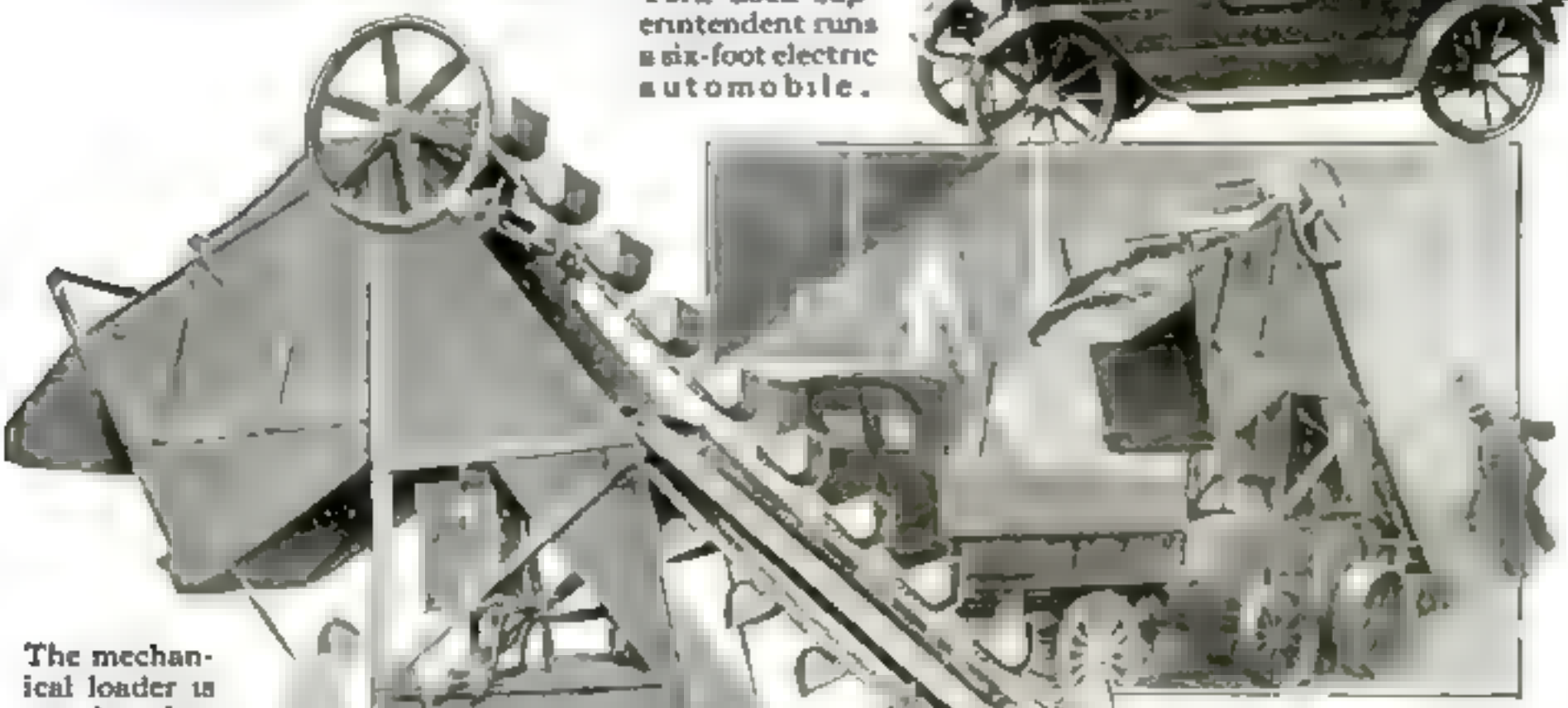
Above: A reel which may be attached to the rear wheel of any automobile intended for the use of telephone companies, can roll up a half mile of wire in less than ten minutes

Above: Unloading a five-ton reel of telephone cable without manual labor by using an ordinary drum-winch placed directly aft of the driver's seat. It is driven by power from the truck



At right: A lock designed to control both the spark and throttle levers on automobiles

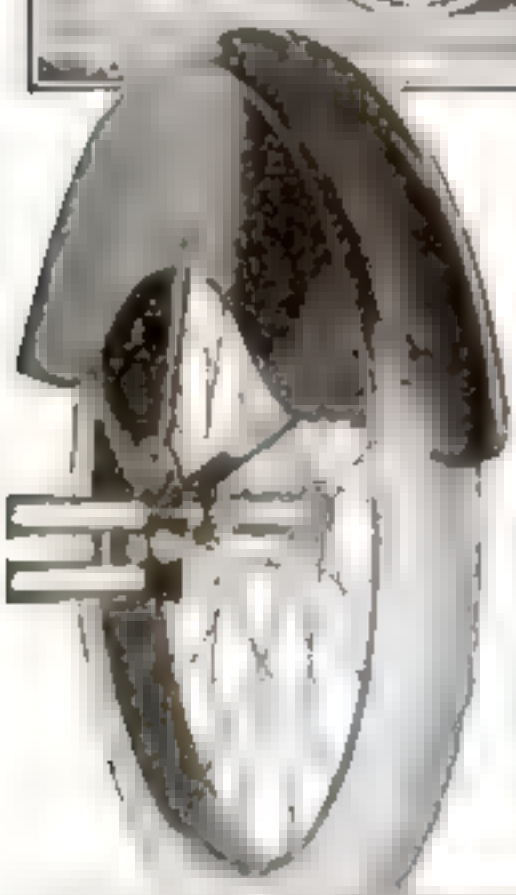
At right: The seven-year-old son of a New York dock superintendent runs a six-foot electric automobile.



The mechanical loader is run by electric or gasoline motor

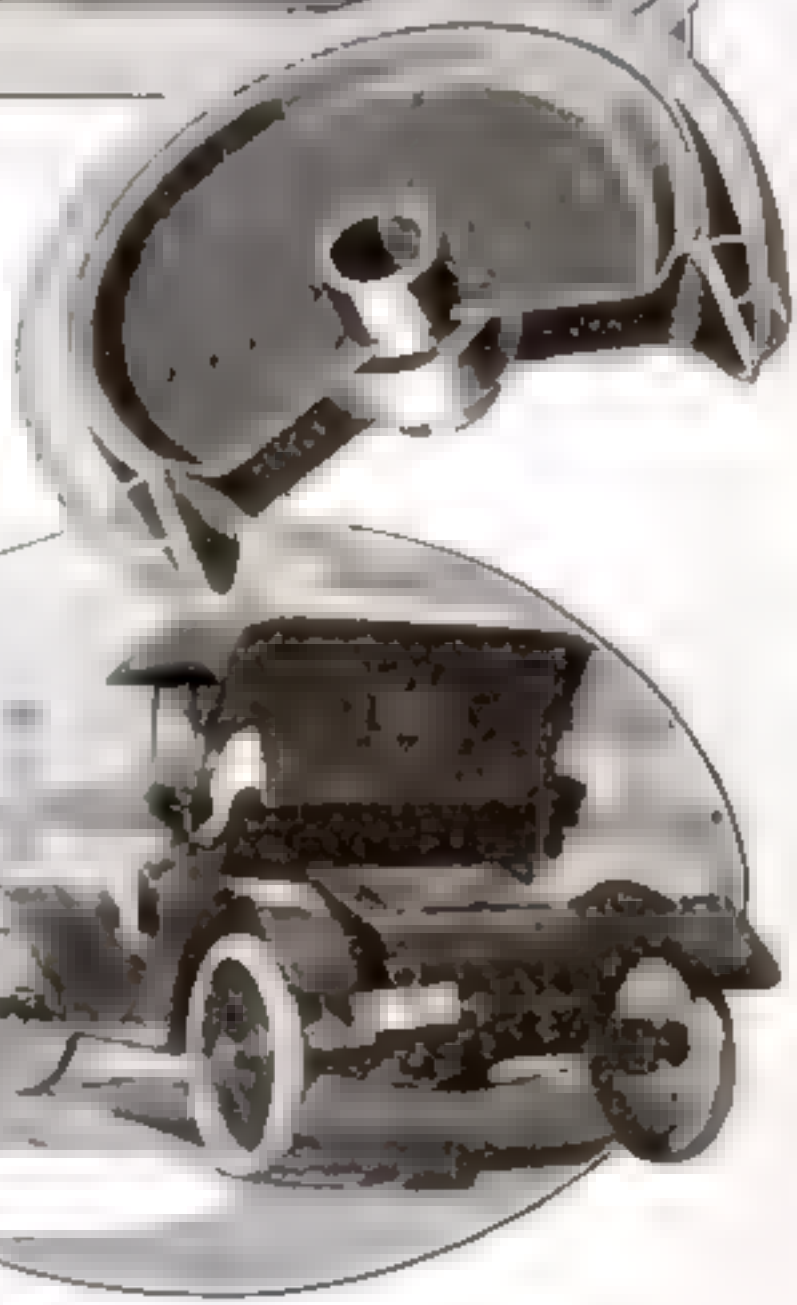
Above: A self-propeled motor-truck and wagon loader. The hinged bucket framework section may be raised or lowered without exertion

Inventions Which Improve the Motor-Truck and Make

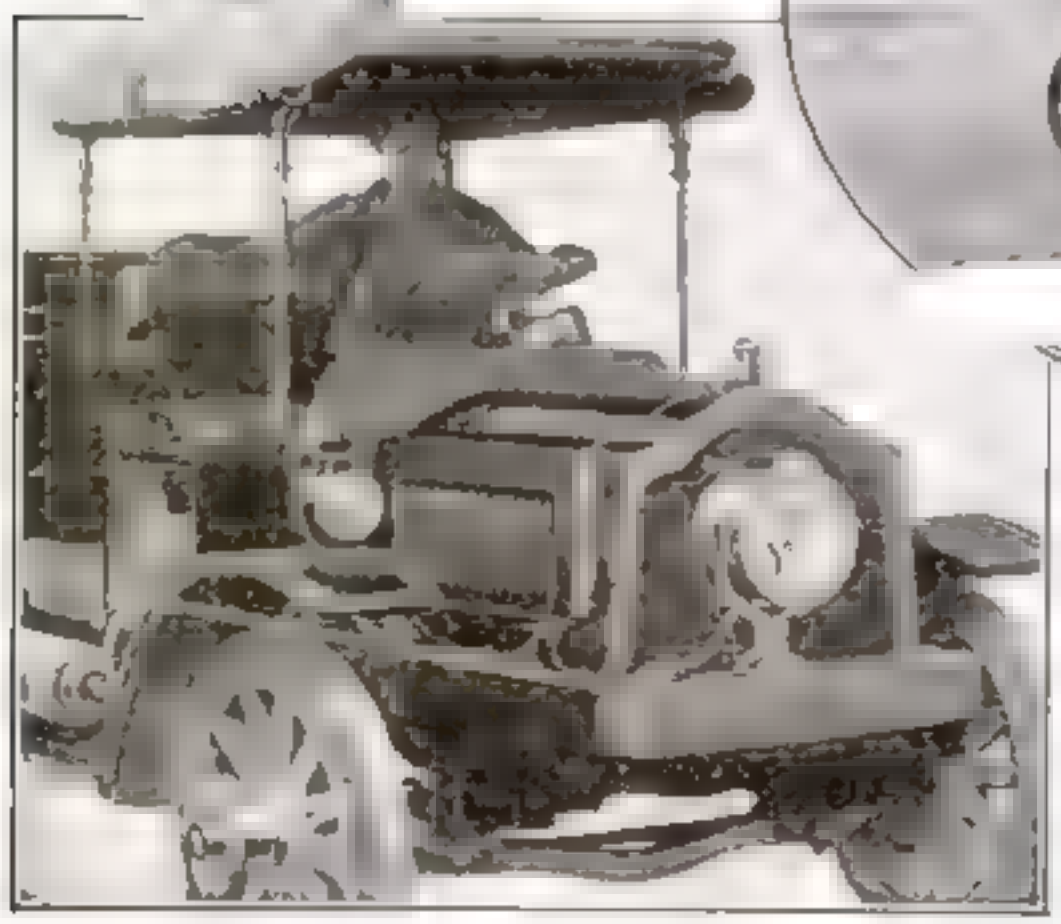


Above, a truck for mine rescue work equipped with a wonderful variety of scientific paraphernalia, including a complete telephone system

At right, a hydraulic pressed steel wheel used on trucks in war service. Its strength is rated higher than that of any other type of wheel made

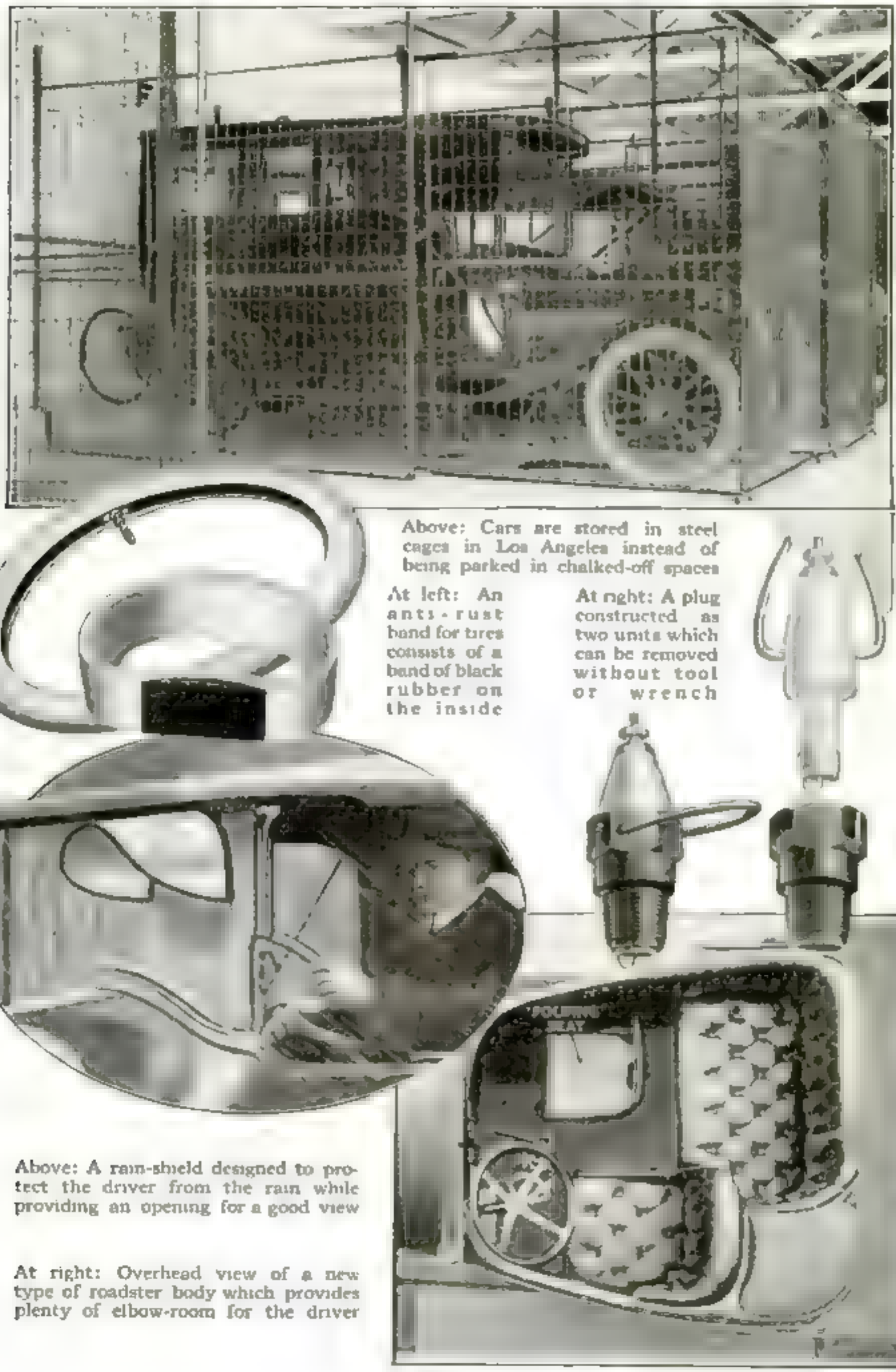


At left, an adjustable two-bar extension rear axle for a motor cycle sidecar



Above: In Long Beach, California, an immense disk is painted in the center of each street intersection as a guide to automobiles and vehicles

At left, a removable motor truck headlight carried only at night. During the day valves fastened to the tube are closed and the headlight is removed from its U-shaped stand in front



Above: Cars are stored in steel cages in Los Angeles instead of being parked in chalked-off spaces

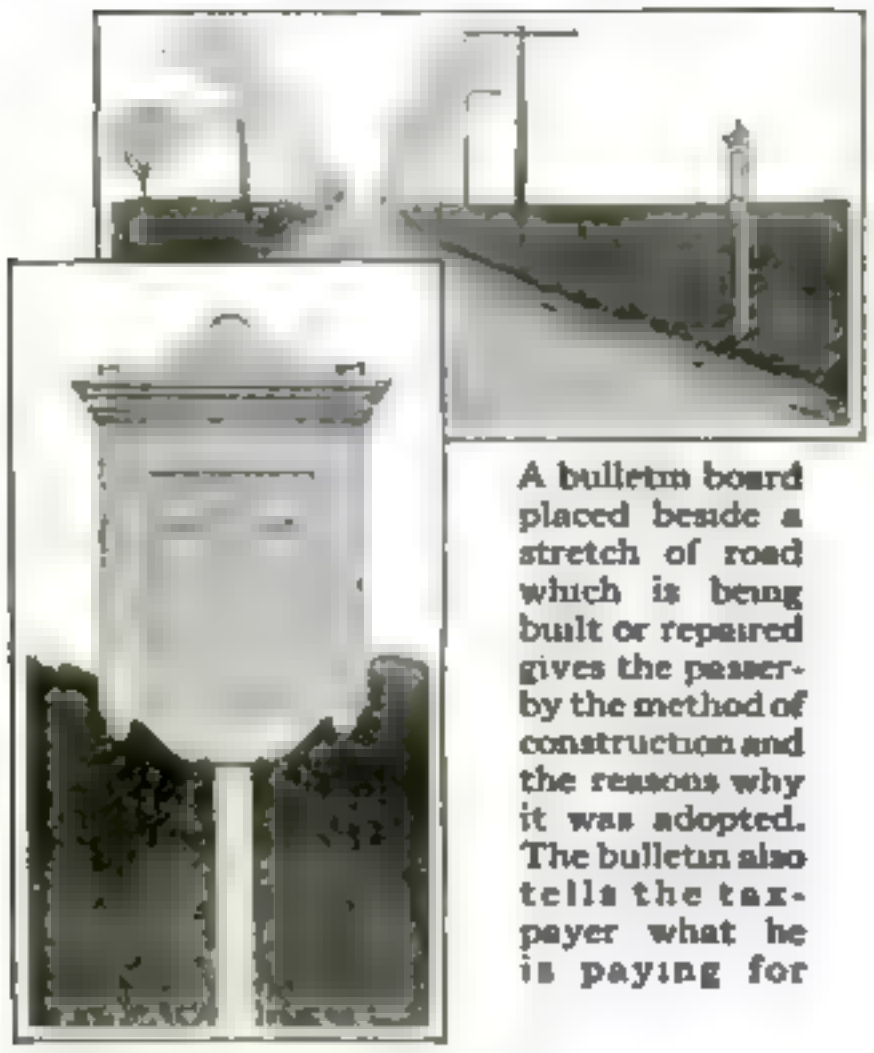
At left: An anti-rust band for tires consists of a band of black rubber on the inside

At right: A plug constructed as two units which can be removed without tool or wrench

Above: A rain-shield designed to protect the driver from the rain while providing an opening for a good view

At right: Overhead view of a new type of roadster body which provides plenty of elbow-room for the driver

Road-Construction Facts by the Wayside



A bulletin board placed beside a stretch of road which is being built or repaired gives the passer-by the method of construction and the reasons why it was adopted. The bulletin also tells the taxpayer what he is paying for

GOOD roads enter so largely into the affairs of the average man in this age of the automobile that a popular step was taken when road-construction facts were given to the public in a new and striking manner. The bulletin board illustrated is in use in and about Philadelphia, where the Chief of the Bureau of Highways, William H. Connell, is telling the taxpayer just what he is paying for in roads.

The bulletin tells all the details of materials and construction in non-technical language. The foundation course is described, as is the surface course, and the surface finish. Then the method of mixing the materials for the surface course is described, and the materials are enumerated.

"Troubleshooting" at Night with the Aid of a Searchlight

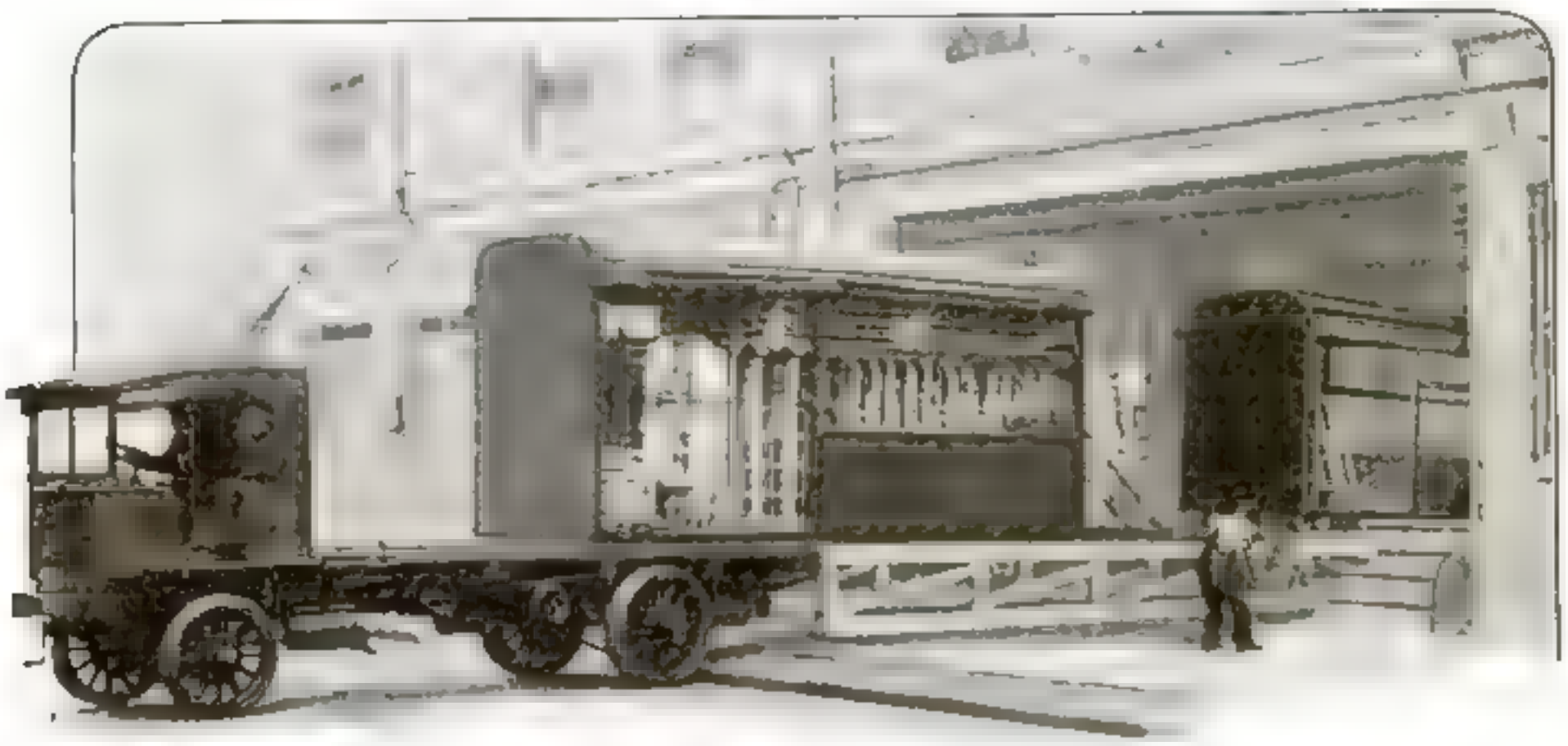
THE "troubleshooters" of the Far West—the linemen who brave the fiercest weather to keep the telephone line open at all times—have already been immortalized in story. It is now the turn of the "troubleshooter" of the big Eastern cities to get his name into the latest fiction as a hero in disguise.

Keeping telephone lines repaired is one of the most difficult of jobs. There is not a day but the superintendent of construction in every big telephone company sends out his corps of linemen.

In Pennsylvania the largest telephone company has a "troubleshooter's" equipment which is the last word in efficiency. A big motor-truck enables the men to get to the particular scene of trouble in a minimum of time. When the call comes in the dead of night the truck aids the linemen with its searchlight which is thrown directly upon the spot. With its aid he does the work easily.

The telephone lineman making a quick repair under the beam of a searchlight which is mounted on an emergency truck

A Motor-Truck That Equals Two



Two detachable bodies, resting on rollers, are pulled on and off the chassis over an inclined platform. While the truck is delivering the contents of one the other is being loaded

TWO demountable bodies and a novel inclined platform have enabled a motor-truck owned by an Eastern manufacturer of beds to do the work of two vehicles. It was very necessary when preparing to transport the beds over the city streets or country roads to pack them into the truck with the greatest care in order to avoid scratching the enamel or other highly polished surfaces during transit, and thus detracting from their value. At first this packing and loading took so much time that the truck was standing idle for long periods. Then the truck owner devised the loading and unloading scheme which is shown in the accompanying sketch.

The apparatus consists of two demountable bodies resting on rollers, so that they can be pulled on and off the truck chassis, and an inclined platform upon which the bodies are withdrawn for loading.

On the top of the platform which consists merely of boards carried on supporting frames, are two sets of wedges, with their thick ends at the center and their tapering ends at the ends of the platform. The tops of these wedges are fitted with channel irons to form troughs in which the rollers on the bottoms of the truck-bodies are constrained to run when the bodies are removed.

The truck arrives at the plant of the manufacturer with its empty body and backs up to the platform. The empty body is pulled off the truck chassis and upon the inclined wedges by means of a rope hooked to the rear end and run over two pulleys to a drum under the platform and operated by means of gears and a small hand-crank. The body is left in this position to be loaded with beds from the main loading-platform, which is directly alongside of the platform on which the bodies of the truck are placed.

The truck then backs up to the other end of the platform, and the loaded body, which has been filled with orders while the goods in the empty body just placed were being delivered, is pushed down the inclined wedge upon the truck in the reverse manner. By the time this load is delivered, the first body is again loaded and ready to be pulled upon the truck after it has again returned. Thus the idle loading time of the truck is practically eliminated.

When on the truck and ready for a trip the body is held in place securely by four folding hasps, two on each side.

Solving New York's Freight Problem

By Herbert Francis Sherwood

A typical scene along the water-front of New York and Brooklyn. Freight cars, lighters, steamers unload their freight, regardless of system, regardless of expense. Every ton of miscellaneous freight carries as much of a charge for terminal handling as it does for rail or water transportation, an average of about seventy cents per ton. New York has by far the crudest and least economical means of freight handling of any great modern city

NATURE has made in New York Harbor the problem of a cheap manner of transferring goods between land and water and the transportation lines and factories, warehouses and stores difficult of solution. This year the complex method evolved for handling freight has been further complicated through the scarcity of ships and the congestion of the railroad terminals in consequence.

It is difficult to realize that if the shoreline of the waters included within the limits of the port of New York was untangled and connected so that it ran more or less directly toward one point of the compass, and a railroad were laid upon it, it would take the Twentieth Century Limited, traveling at an average speed of fifty miles an hour, fifteen and one-half hours to traverse it. The number of miles of waterfront is 771. Of this total, 578 miles are in New York city, the remainder being the New Jersey shore extending along the Hudson River from the upper end of the city around the Lower Bay to the lighthouse and artillery proving grounds on the extremity of Sandy Hook. Unfortunately, there is no railroad along the busiest part of this great shore front. This is what distinguishes the problem of handling freight in New York Harbor from that of other ports. One commission after another has looked at the problem and found it like a mountain front. They have tried to scale it, but this has proved more difficult than the ascent of Mt. McKinley.

In the old days, when masters of ships had an opportunity to show how to dock a vessel with every sail flying, and

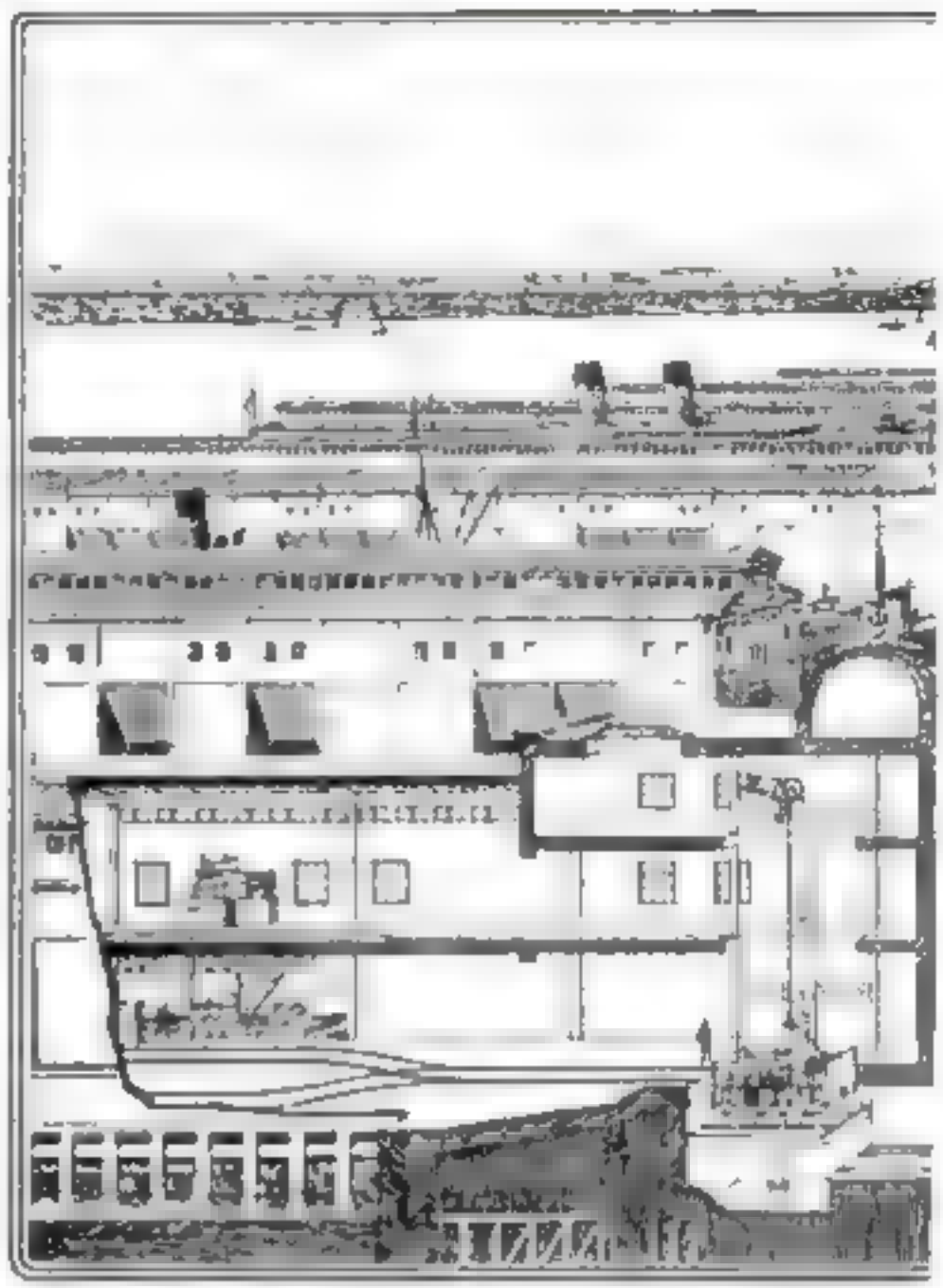
did it with an artistry that was at once a source of envy and a joy to behold, the fact that New York city was on an island did not count so much against it. Waterways were the chief highways. And New York had the advantage over every other port on the Atlantic coast in that one of its highways to the interior was a waterway that cut across the Appalachian system at sea level. It was in the days following the opening of the Erie Canal, giving it access to the Great Lakes and the heart of the continent, that it leaped ahead in the race for commerce.

Much of New York city's freight is transferred to lighters after having arrived on ships, and is then loaded upon carts. Millions are annually thus wasted in useless handling

The railroad, however, has demonstrated that it can compete successfully with the interior waterways in getting the products of the rich farms of the Mississippi Valley to the seaboard. So now, New York is handicapped by the fact that it is surrounded by waterways the most important of which cannot be bridged for the transportion of freight. Moreover because of the narrowness of Manhattan Island, there is little room for freight yards, and little opportunity for getting cars onto the piers alongside the steamships. Having little space on a horizontal plane, the pressure has shot the inhabitantsup into the air, and down into holes in the ground, where they work, where they travel and where they live.

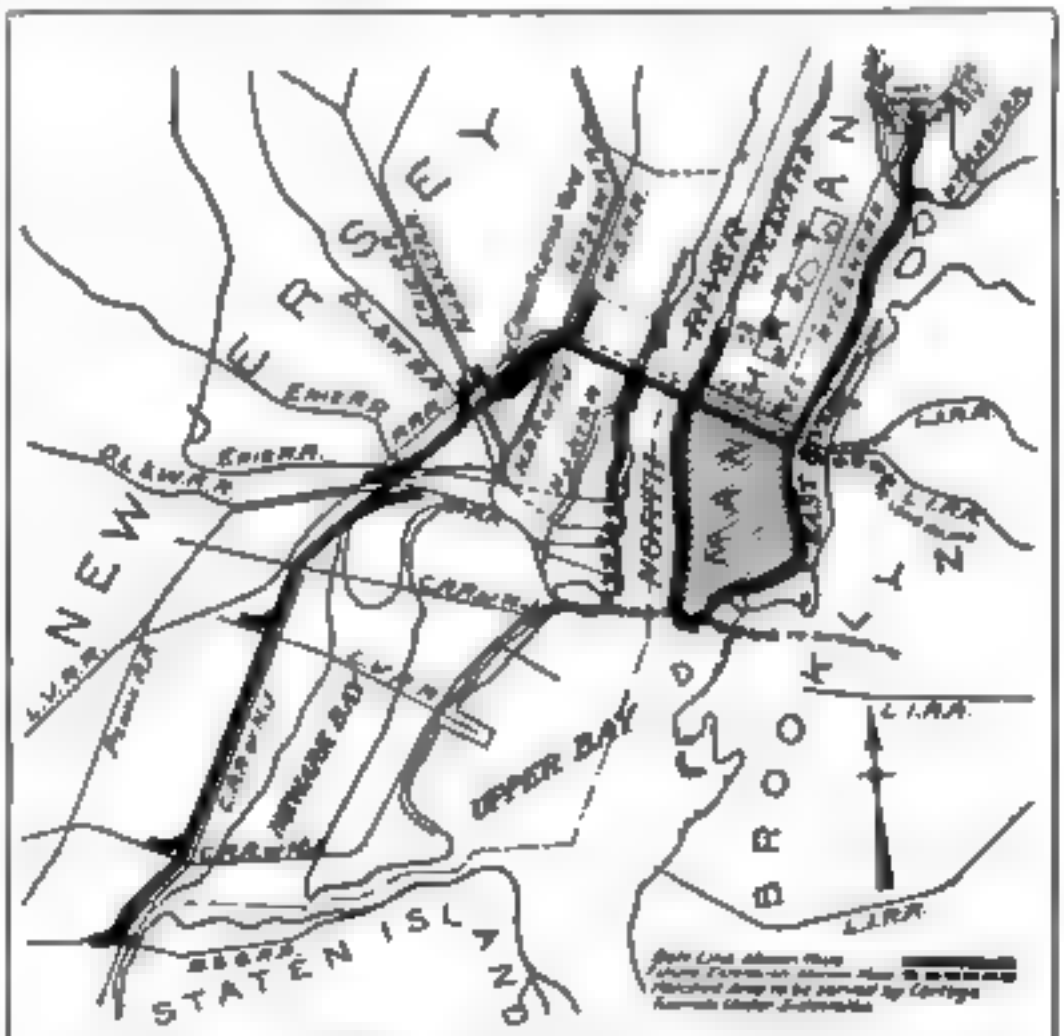
New York's methods of handling freight at its terminals is discreditable to the largest city of the western hemisphere. Freight is handled and re-handled, transferred from ships to lighters, and from lighters to carts. If we could cut the cost of handling the freight of the country by only one cent per ton, it would mean a saving of $20,000,000 each year. Every ton of package freight in the United States bears a charge of 74 cents for terminal handling

Notwithstanding the handicap, however, nearly half of the foreign commerce of the United States passes the Ambrose Channel and Scotland Lightships swinging at the entrance of the two pathways into the harbor. It is not until one stops to realize that New York's foreign commerce is equal to that of Portland, Me., Boston, Providence, Philadelphia, Baltimore, Norfolk, Newport News, Wilmington, N. C., Charleston, Savannah, Jacksonville, Tampa, Mobile, New Orleans, Galveston, San Francisco, Portland, Ore., Seattle and Tacoma combined, that one can appraise that statement at its worth. Despite the fact that all raw material must be transported many miles to its factories, New York City is the greatest manufacturing community in the United States. At least one-tenth of all the manufactured goods produced in this country are fabricated within its borders. It has been asserted that the city is the food market for 15,000,000 people. And yet only one of the great trunk lines can run its freight trains directly into Manhattan.

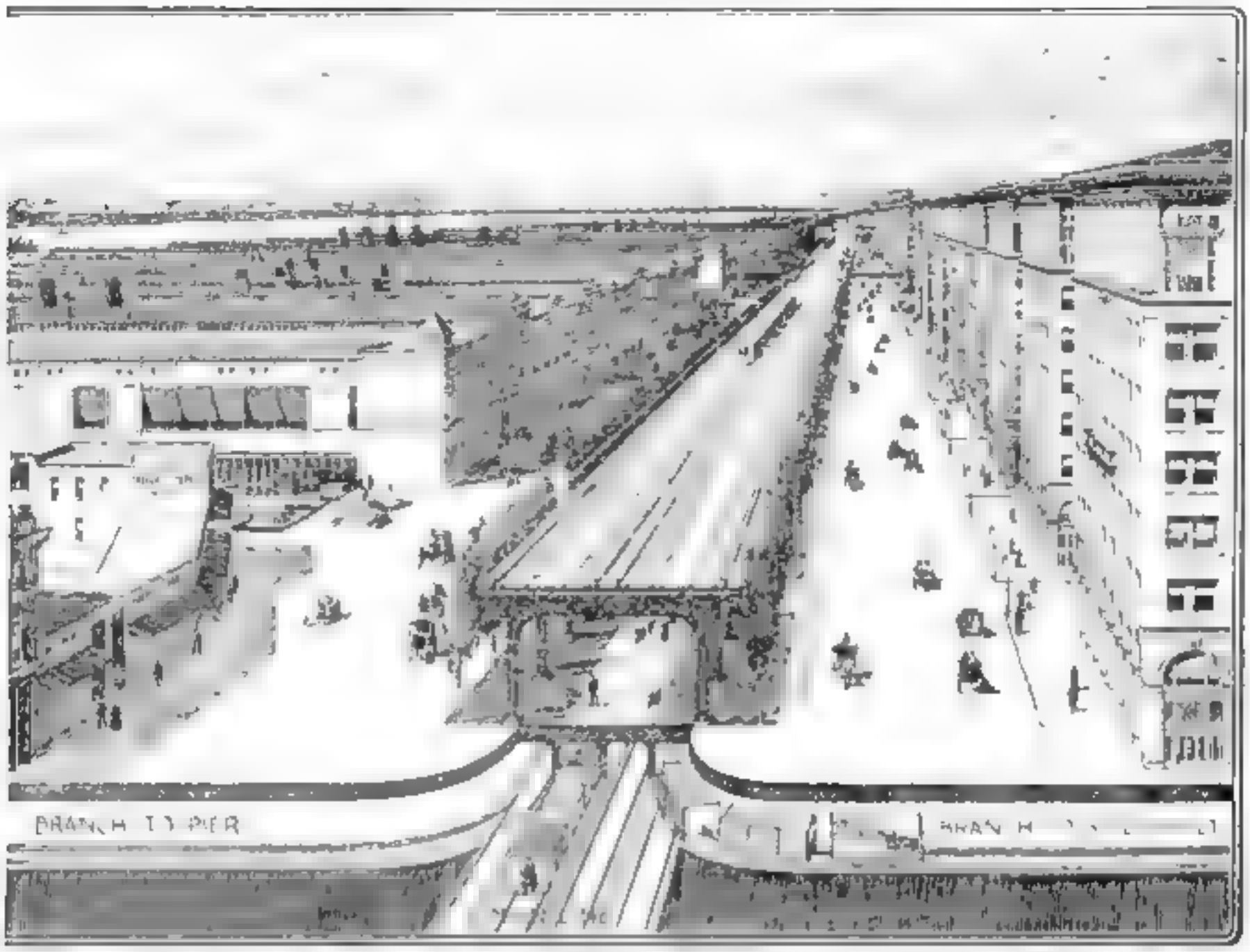


The Wilgus freight subway for New York city is to extend throughout the city. Branches will

Ranking first in some respects among the four chief ports of the world, its waters are probably busier than those of any other port, for a large proportion of its freight must be distributed and collected upon them. Therein it resembles Venice. One Saturday afternoon the writer stood for an hour on the Battery Wall watching the various types of vessels ranging from great ocean-liners to snorting grimy motor-boats moving over the ever-shifting surface. In the course of that time, 183 passed on one side or the other, an average of more than three per minute. There is probably no busier bit of water in the world. The last report of the New York State Commission to Investigate Port



Instead of loading and unloading freight several times during transit from New Jersey to New York city, Mr. Wilgus would send it by rail under the river directly to its final destination



run beneath the piers of the great ocean steamships. Whole freight cars will be raised and lowered by elevators, and branches will run through the side streets to the consignees

Conditions in New York Harbor, which is dated August, 1915, points out that the total amount of goods moved on the waters of New York Harbor, other than that on ferry boats, in the year 1906 was 113,969,355 tons. No one knows what it was worth, but one student of harbor conditions guessed that it would take approximately ten billion dollars to meet the invoices.

One-quarter of the ferry boats of the United States were to be found in New York Harbor at that time. There were also 5,289 unrigged boats for moving heavy freight around the bay and adjoining waters. One-half the tremendous volume of products was transported on lighters. A considerable part of the equipment for handling freight is owned by the railroad companies that have no tracks on Manhattan and cannot lay them down on the island.

In most communities it is practicable to run tracks alongside the piers, factories and warehouses. It has not been so in New York City in the past. The manufacturers and merchants have been obliged to rely upon trucks to get their goods from the railroads and ships to their places of manufacture, storage and trade.

This has always caused great congestion along the waterfront, particularly that of Manhattan. Here the railroads compete with the steamship companies for space to land their freight. The railroad companies do this by establishing depots on piers, alongside which they bring great carfloats, floating switches they might be called. So general is the use of carfloats that it has been said that every morning the terminal yards of the great trunk lines in Jersey City, Hoboken and Weehawken are detached from New Jersey and drawn across to New York City, being returned again at nightfall.

Trucking, however, in New York City is costly owing to the high expense attached to housing and feeding horses and the length of time required to get a load to or from the waterfront because

New York city wastes millions in cartage. If the Wilgus plan is adopted, a freight subway will run through New York city, paralleling the present [illegible] subway in some sections, for the purpose of transporting the freight underground and through tunnels under the Hudson River to its destination, thus saving the additional expense of re-transference

of the congestion at that point. It has been stated that it cost more to haul a ton of freight from a railroad terminal in Jersey City to a warehouse in Manhattan than from Pittsburg to the seaboard. R. A. C. Smith, Commissioner of Docks and Ferries, has suggested that the time required to load the trucks might be reduced by constructing pier-sheds in such a way as to permit the trucks to go out upon them at one side, enter in order through a series of doors, and return in a regulated procession. William J. Wilgus, a former vice-president of the New York Central Railroad, has submitted to the public Service Commission a project for transhipping freight to smaller cars at a great terminal yard to be established on the Hackensack Meadows. These cars were to be operated by electricity through tunnels under the Hudson River

to Manhattan, where they would be distributed to the consignees by means of small subways constructed under the sidewalk. They were to be unloaded directly upon the basement platforms of the consignees and reloaded. The recent development of the motor-truck, which makes possible the transportation of larger loads than in the case of horse-drawn trucks, has suggested another solution of the problem. It is proposed that a standardized chassis be designed to carry a standardized van-body, which can be carried on one of these subway cars from the classification yards on the Meadows. This would be placed on a chassis at the terminus in Manhattan and run to the destination of its contents. It can be returned filled with other goods just as railroad cars are shifted from one region to another. A crane would be used to transfer the great box from the motor chassis to the car and back again.

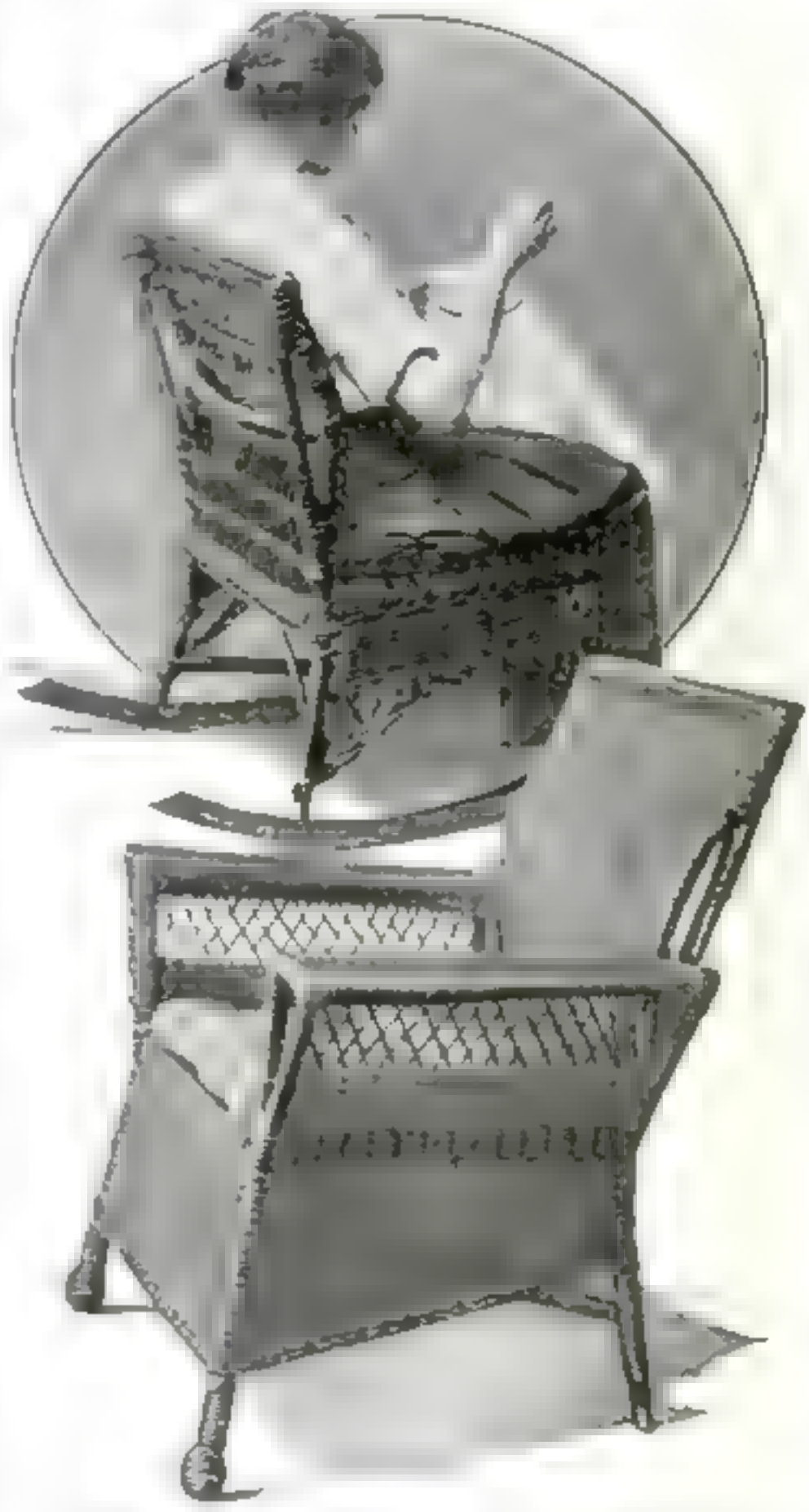
The ideal solution would be a series of terminals similar to the Bush Terminal circling the harbor in Brooklyn, Staten Island and New Jersey and connecting with a belt-line railroad by car-floats and tracks. The belt-line railroad would run around the rear of Jersey City and Hoboken and be operated in the interest of all the intersecting railroads. At the intersections would be transfer and classification depots. This would make it unnecessary for the railroads to maintain independent stations in every borough and reduce the cost of delivery. In addition, this belt-line road might maintain a truck delivery system just as the railroads do in London and the express companies do here. Already a proposition to establish a terminal at Bayonne similar to the Bush Terminal is being discussed. It might become the transfer point and terminus of such a belt-line railroad.

How Do You Sit?

A CHAIR is like a shoe, doctors say nowadays. It is comfortable only when it fits the body. And they also say that the ordinary chair does not fit the body, no matter how much upholstering or padding it may have. So they have gone to work and built a chair that fits the body to a "T".

See that hump in the back in the accompanying illustration? The purpose of this is to fit into the bend of the back in such a way as to afford support to the back and thus allow the muscles to relax and rest.

In the case of the ordinary chair the hump is not in the chair, but in the person sitting down. His shoulders stoop forward, his body slumps down, the abdomen is thrown forward and the abdominal organs get out of place. The new chair corrects this defect



The hump in the chair fits the bend in the back in such a way as to afford perfect support

Ten Millions to Save Four Miles

IN the Canadian Rocky Mountains is a giant mass of rock, towering 8,540 feet and known as Mount McDonald It lies on the route of the Canadian Pacific Railway. Between Mount McDonald on the right and Mount Tupper on the left, the road enters what is known as Rogers Pass. To reach the other side of the Rockies, the trains had to climb two long spiral loops. If they were to tunnel through the mountains the route would be shortened only about four miles, but the grades would be reduced, with the result that much time would be saved as well as wear and tear on rolling stock. Besides, the expense and danger of maintaining and operating four and one-half miles of snowsheds would also be eliminated. Considering these factors, as well as the amazing increase in traffic, an increase which involved double-tracking, it was decided to tunnel Mount McDonald.

Two years were spent by engineers in seeking the most favorable location for a bore. A spot was discovered best suited for an undertaking in civil engineering which compares favorably with the wonderful tunneling that has been done in the Swiss Alps.

The Selkirk Tunnel, as it has been called, is of interest because of the unusual method employed in the boring. In all such work it is important that the excavated material shall be removed with the greatest facility; that the work under way shall not be impeded; and that provision shall be made for carrying high-pressure air pipes for the drills, water pipes and ventilating suction pipes. And so it was decided to dig two tunnels —one of them a "pioneer tunnel," in engineering parlance, the sole function of which is to provide an outlet for the excavated material.

If you will study the pictures appearing on the next page, you will see at once how the pioneer tunnel fulfils its purpose. At the east end the pioneer tunnel was located fifty feet to the north of the center line of the main tunnel and at the west end, fifty feet to the south of it. First of all, an upper center "heading" was dug. In other words, a rather shallow channel was dug along the line of the main tunnel. After this center heading had been made, the work of digging out the main tunnel to its full dimensions proceeded. The material excavated was hauled to the pioneer tunnel, which runs parallel with the main tunnel, through cross-cuts, following the course shown by the arrows in the diagram on the following page.

After being conveyed through the pioneer tunnel, it was carried back again to the main tunnel, but, of course, at a point far removed from the scene of operations. After that, it was hauled out on a trestle over standard-gage tracks through the main tunnel and dumped into regular railway cars. The excavation was, of course, all done by steam shovels of one and a half cubic capacity, which means that at a single scoop, a shovel would dig out about an ordinary wagonload of dirt and rock. The dirt cars were hauled to the mouth of the tunnel by standard-gage compressed-air locomotives.

The tunnel, which is five miles long, lowers the summit of the line by five hundred and fifty-two feet. Its estimated cost is over ten million dollars.

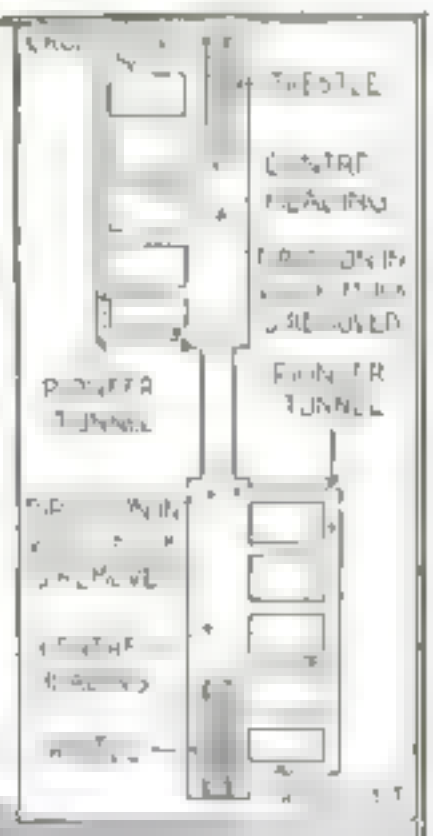
The tunnel is twenty-nine feet wide and twenty-three feet high and follows a straight line under Mount McDonald, emerging in the Beaver Valley beyond at a point about one thousand feet below the present railroad route.

The eastern end is directly below Hermit, a station just east of Rogers Pass. The highest point reached in the tunnel is three thousand seven hundred and ninety-five feet below the summit of Mount McDonald peak. Up to the interior summit the passage through the tunnel has a grade of one per cent. The climb for the tunnel is made by the railroad on the most northerly station on its route. The tunnel route originally discovered by the engineers was six miles long, but this was gradually decreased to conform to the five-mile tunnel. The pass gets its name from Major A. B. Rogers, who penetrated the fastnesses of the Selkirks in 1861 and discovered this opening through the range.

Tunneling Through the Canadian Rockies

One of the intersections of the pioneer tunnel with the main tunnel. Horses were used to haul the muck cars to the point where they were dumped into railroad cars. From this point to the mouth of the tunnel standard-gage compressed-air locomotives were employed

A view of the entrance to the tunnel under Mount McDonald. It emerges at a point in the Bear Valley about one thousand feet below the present railroad route



In the lower picture the mountain is shown sliced away to reveal the pioneer and main tunnels, as well as the laterals connecting the two. The material excavated was hauled through the pioneer tunnel and then through the main tunnel as indicated by the arrows in the diagram on the right

Bucking a Wooden Football Line

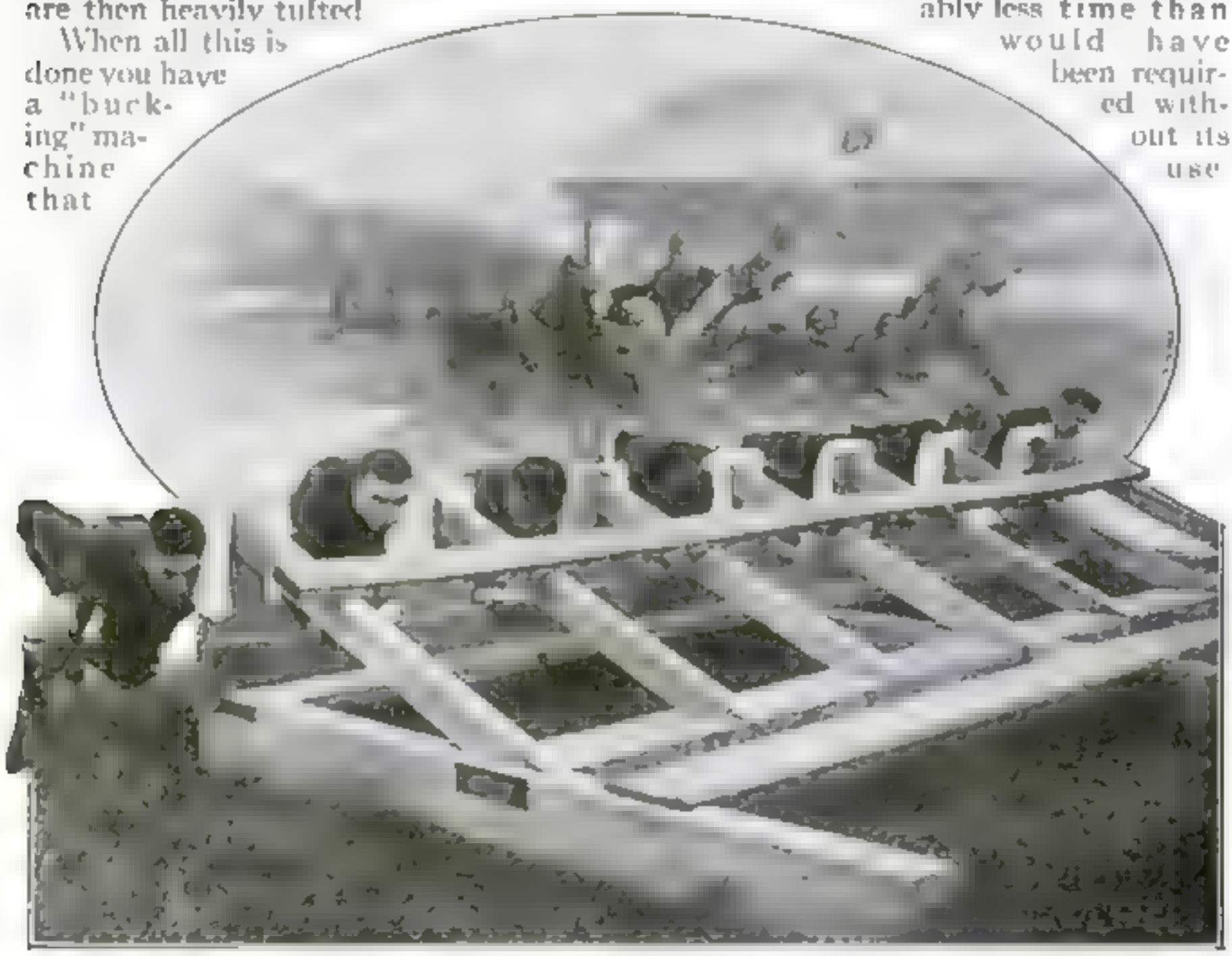
PUTTING your shoulder to the wheel of opposition and developing strength and power from the struggle is an ethical procedure in the generally accepted meaning of the words. But football players have not only reduced the axiom to practise but have even manufactured a sturdy opponent which is equal in weight and resistance to seven human beings.

Heavy oak planks ten feet long, one foot wide and four inches thick are put together in pairs and laid seven feet apart, with one end each rounded like the runner of a sled. Cross-beams of similar material are then fastened in place until the whole resembles the framework of a sled. Seven planks three feet long and one wide are placed in an upright position along the back of the framework and braced by heavy timbers to the cross beams. The uprights are then heavily tufted.

When all this is done you have a "bucking" machine that is used to train football players in the gridiron sport. This apparatus is really for the line men to use, and its weight is approximately that of seven football warriors who constitute the line of an opposing eleven. Against the tufted uprights seven players hurl themselves with as much force as if a game were actually on, and the sledge-like mechanism is pushed over the turf sections of the field.

At the opening of the season, when the players are somewhat tender, the weight of the apparatus is lessened. As the men become hardened to the demands of the sport, weight is increased by the addition of several timbers and sometimes a heavy stone. The "bucker" has proven a valuable aid to both trainers and players.

It has been found that the men trained to it are prepared in considerably less time than would have been required without its use



The weight of the apparatus is approximately that of the seven men who constitute the line of the opposing eleven. As the season advances the weight is gradually increased

The Czar of the Power-House

By the mere pushing of a few buttons on his desk the man who controls the delivery of current from a great power-house can stop all street cars, put out all lights and shut down hundreds of businesses dependent upon the power

THE man who controls the outgoing current from a central power-house is a Czar whose domain may cover all territory within a radius of one hundred to five hundred miles of the station. By the mere pushing of a few buttons on his desk he can stop all street-car systems and every interurban railroad. He can put out every light, cool every electric flatiron, cause mills to shut down—in fact deaden every activity in his territory dependent upon electric power. The men down in the great power plants await his call. At a signal from him they let loose or restrain huge turbines—machines in some cases each capable of putting forth ten or twelve thousand horsepower, more sometimes than half a state uses in all its industrial activities. Outside men patrol the long transmission lines. If trouble develops in any one district an automatic signaling system apprises the dispatcher of the fact, and by means of telephones at his elbow he mobilizes the men. All energies are bent toward making immediate repairs.

If a lightning and rain storm is approaching, a wireless system acquaints him of its coming. Lightning is the dispatcher's principal enemy. Often the wireless system tells of approaching storms, even though the sky be clear.

Only in times of emergency does the load-dispatcher exert his full powers. Huge central stations are often under contract to supply uninterrupted service. Sometimes they incur heavy penalties if contracts are not carried out. The dispatcher is simply a man made in part responsible for the smooth working of the system. When the street cars, elevateds, and subways are taxed to the utmost in carrying home-going crowds, he is the man who has had extra boilers put in service and extra engines started in order to carry the suddenly increased load. So, too, he prepares for the many lights of evening.

Sampling the Drinks for an Entire Large City

Cincinnati's water is tested three times a day. If it is not pure this man makes it so

IN the employ of the good city of Cincinnati is a doughty knight of the sack who attends to the sampling of the water which, after all, forms the basic drink of the city.

The water to be taken internally by Cincinnati is tested at least three times a day, in ordinary times, and oftener in seasons of high water and the like.

Regulation tests are made for both alkalinity and turbidity. After the analysis has been made there is dumped into the water sufficient quantity of iron to form ferric-hydroxide (a jelly-like substance), which settles out whatever there may be of impurity remaining.

That is to say, the water taken from the Ohio River by Cincinnati is first led into settling-basins, where sixty to sixty-five per cent. of the mud is removed by simple sedimentation. The water is then run to the filtration plants, where the sulphate of iron solution and the lime-water are added. These chemicals react and yield the ferric-hydroxide, which is insoluble in water. As a result, the greater portion of all remaining impurity settles in the coagulating basins, as they are called. By this process perhaps thirty per cent of the original amount of mud and the like is removed.

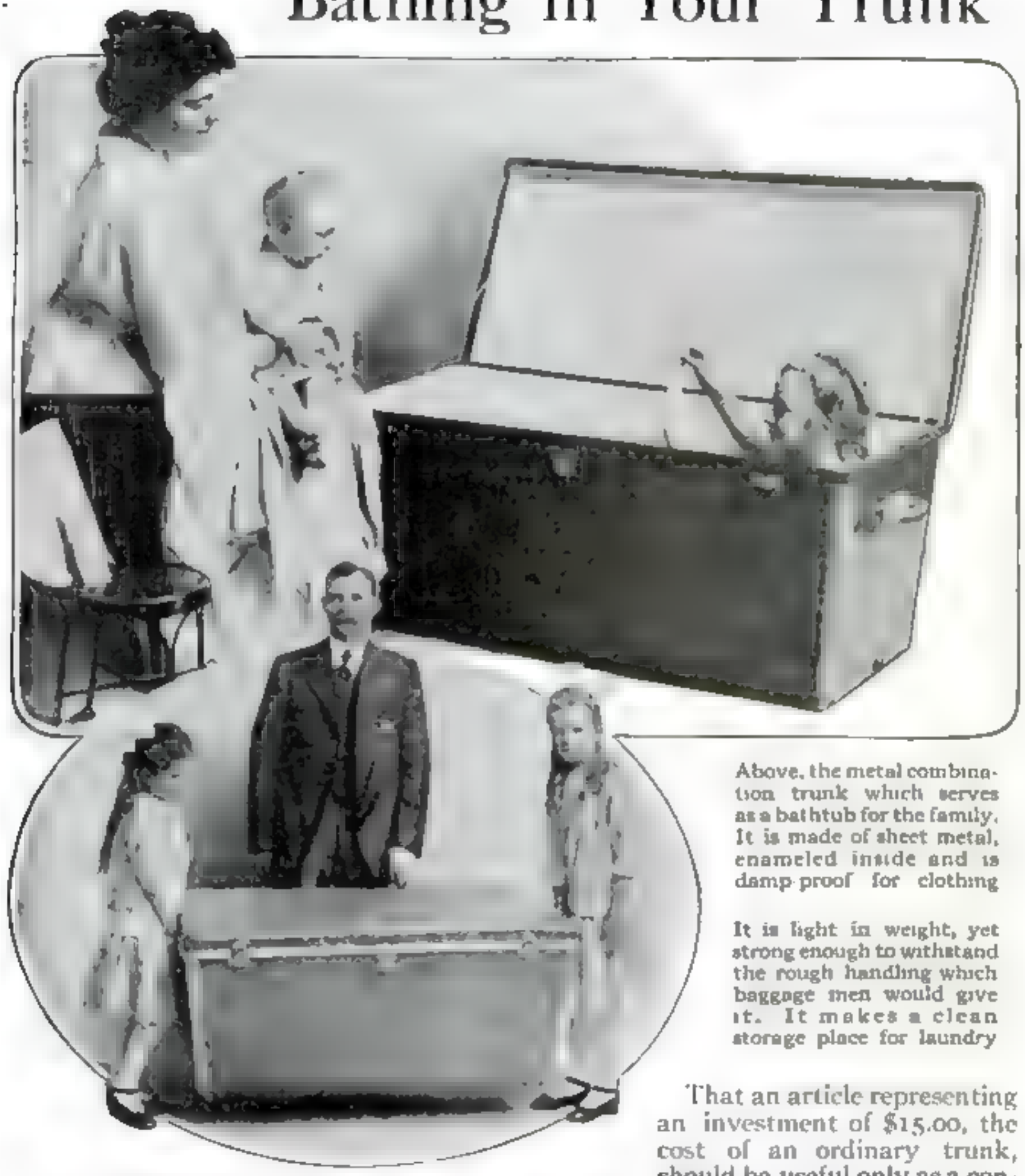
The remaining five per cent to ten per cent deposited is then filtered out by the sand-filter and the water is then ready to drink.

What Is the Leaning Tower of Pisa Compared with This?

A CHURCH in a little Connecticut town has become a famous landmark in the state as a result of a severe storm. A few years ago the spire was blown off and in falling made a half turn and dived through the roof, driving its point through the shingles. There it has remained ever since, and as the photograph shows, it presents a decidedly "misplaced" appearance.

The spire was blown off the steeple and its sharp end pierced the roof and stuck

Bathing in Your Trunk



Above, the metal combination trunk which serves as a bathtub for the family. It is made of sheet metal, enameled inside and is damp-proof for clothing

It is light in weight, yet strong enough to withstand the rough handling which baggage men would give it. It makes a clean storage place for laundry

A COMBINATION trunk, laundry basket and bathtub is the novel invention of Ole C. and Hannah Lee, Ronan, Montana. The trunk is made of sheet metal, enameled inside and outside to adapt it for use as a bathtub or laundry tub, and it is also provided with an outlet at the bottom, to which a hose can readily be attached to draw off the water. Besides giving very satisfactory service as a bathtub, the trunk is a clean storage place for laundry.

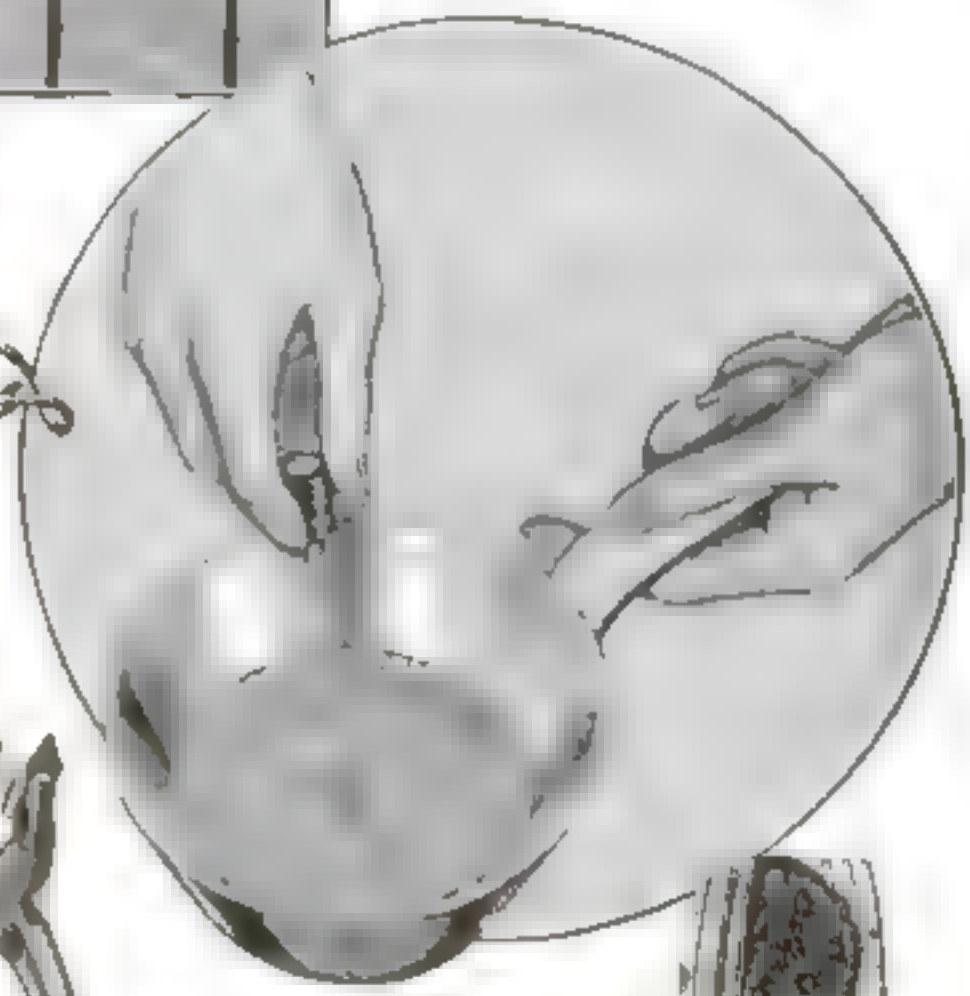
That an article representing an investment of $15.00, the cost of an ordinary trunk, should be useful only as a container for clothing when traveling, struck the inventor as a waste of capital. What is more, the ordinary trunk does not protect the contents from dampness. This led to the invention of a metal combination trunk, which, while comparatively light in weight, is strong enough to stand the rough handling trunks are apt to receive at the hands of baggage men. Although the inventor has made his bath trunk in only one size, it can be made in other sizes.

Housekeeping Made Easy

This is an adjustable curtain sleeping tent supported by rods fastened to the window casing, making an inexpensive and easily attached substitute for a sleeping porch

The frame supporting this sewing basket is collapsable so that it may be folded up and tucked away

Below: A strainer for gravies and sauces. It has a heavy wire attachment for pressing out the lumps



On the right: A strainer with extension rods to fit the rims of various vessels

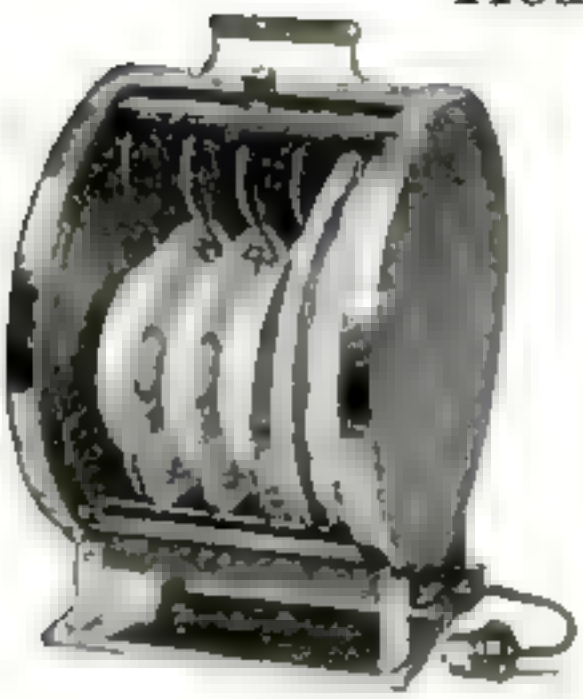
Below: A cutter for decorating fresh fruits in attractive designs for the table

Small rubber-covered wheels clamped to the rockers will convert any ordinary rocking-chair into a wheel-chair

Above: A medicine-cover and tray The cover fits any ordinary glass and the tray holds the bottles and protects the table from stain

On the right is a double fork, useful in removing potatoes or other vegetables from the pot or oven without breaking them

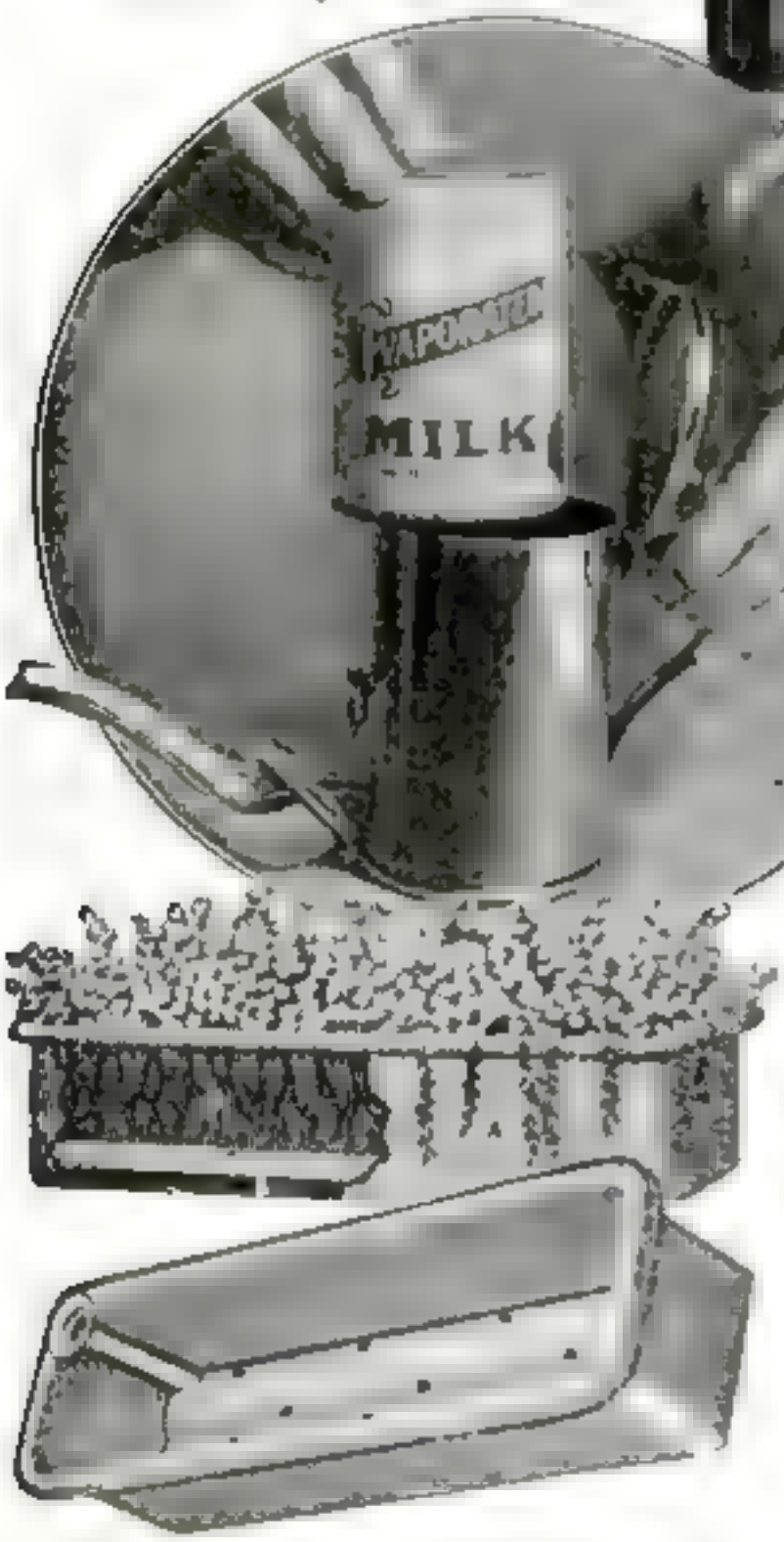
Housekeeping Made Easy



Above, an electric plate-warmer which connects with any light socket. When closed it will retain the heat for hours without current

Below, a device for serving condensed milk or syrups from the original cans. The spout has a sharp end which perforates the can

This new type of kitchen cabinet incorporates a stove and a refrigerator, both of which are completely shut from view when not in use



A neat and attractive flower-box for the window garden has a tube for watering and a perforated false bottom

This combination potato masher and whip is light in weight but very efficient

Two more or less unpleasant tasks may be quickly accomplished with this combined pot-scraper and fish scaler

This kitchen sink has an attachment on each side which provides extra space whenever desired

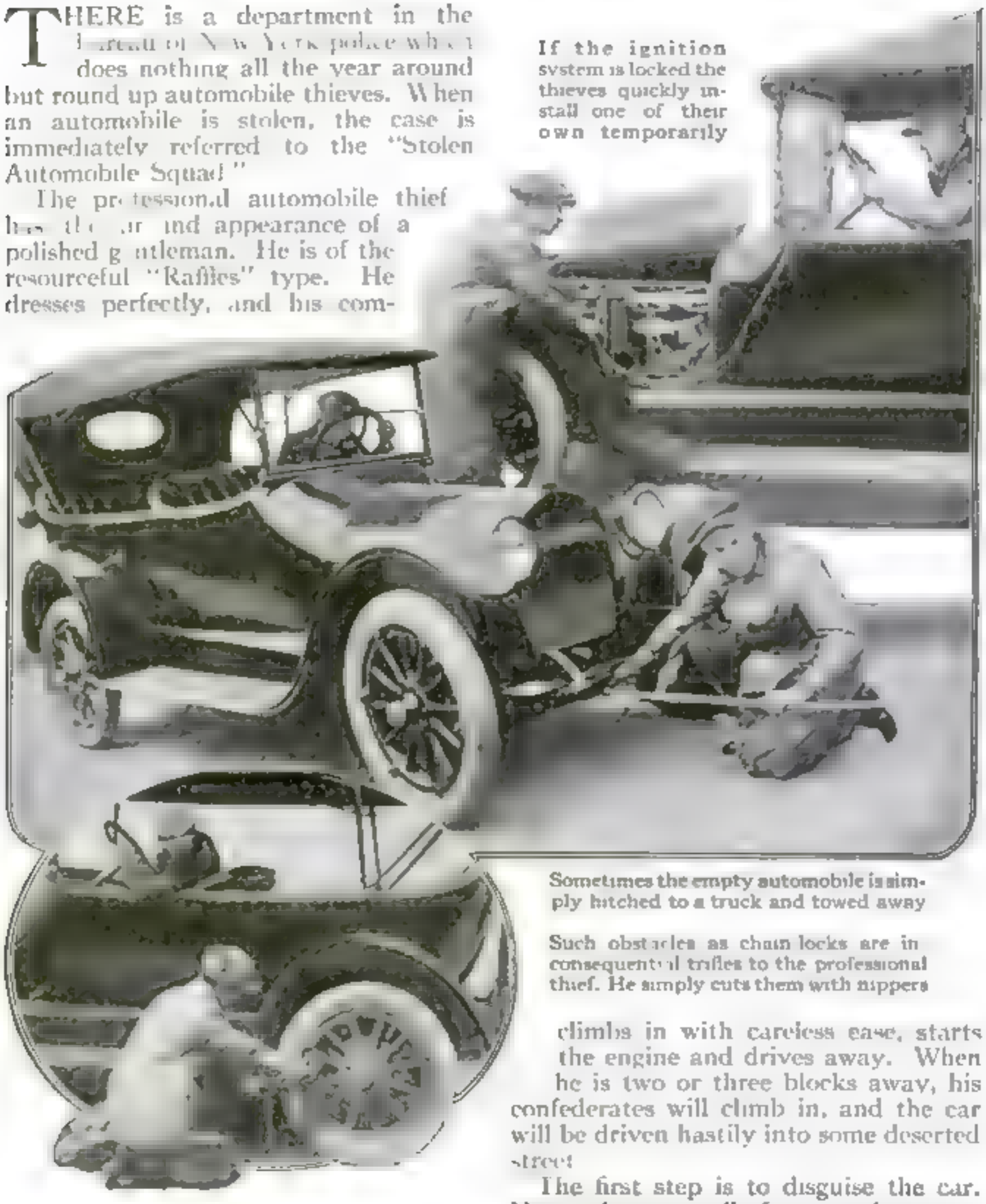
The Wiles of the Automobile Thief

THERE is a department in the Bureau of New York police which does nothing all the year around but round up automobile thieves. When an automobile is stolen, the case is immediately referred to the "Stolen Automobile Squad."

The professional automobile thief has the air and appearance of a polished gentleman. He is of the resourceful "Raffles" type. He dresses perfectly, and his command of English is great enough to deceive the most suspicious of policemen. His ingenuity seems to be boundless.

It may be that an automobile thief has stolen a car under your very nose! He is the last man you would suspect. He approaches an empty automobile, climbs in with careless ease, starts the engine and drives away. When he is two or three blocks away, his confederates will climb in, and the car will be driven hastily into some deserted street.

The first step is to disguise the car. Name-plates, usually from another state, are hastily clamped over the original plates. The hood is lifted, the serial number of the engine is filed or ground away, and new numbers are stamped in their place. The numbered plate on the running-board is removed and another substituted. Impedimenta, such as mir-



If the ignition system is locked the thieves quickly install one of their own temporarily

Sometimes the empty automobile is simply hitched to a truck and towed away

Such obstacles as chain locks are inconsequential trifles to the professional thief. He simply cuts them with nippers

rors, clocks, etc., are carefully removed. The car, thus altered, is driven away. If a suspicious traffic policeman should

The thieves substitute new license plates and a new serial number on the engine to satisfy the suspicious traffic police

stop the car, the courteous gentlemen who are riding in it will present an identification card to correspond with the new license plates. They point to the serial number on the engine. Is it not different from that of the stolen car? And so, they ride away safely, unless the officer is unusually astute and persistent.

Sometimes your thief drives in a motor-truck alongside an empty automobile, hitches the two vehicles together, and tows the automobile away as if it were disabled. Such obstacles as chain-locks are inconsequential trifles. Sharp wire-cutters end the usefulness of all small chains.

Again, if the ignition system of a car is locked, the knights of the road quickly install one of their own temporarily. If the gasoline tank is locked, it is a simple matter to syphon enough gasoline from a beer pail into the carburetor for a short run into a different locality.

One band of enterprising automobile thieves eventually captured in Kentucky stole forty-seven Ford cars in New York City within six months. They specialized on doctors' cars, because they realized that when a doctor paid a call he usually left his car standing unguarded for a half hour at least, unless he happened to have a chauffeur or a guest in his car, in which case, of course, it was safe from the thieves.

Many manufacturers of high-priced automobiles stamp in some inconspicuous place identification numbers upon a permanent, immovable steel part and then paint over the numbers. When doubt arises as to the ownership of the car, the paint is scraped off and the owner's identity revealed instantly by consulting the sales record of the manufacturer or selling agent.

A New Gasoline-Motor-Driven Road Roller

THE old-fashioned steam-roller, with its heat, its smoke and its noise, has at last been supplanted by the roller which is shown in the illustration, which may be started at a moment's notice and has no fire to kindle, no steam to get up and no coal to carry. It is driven by a gasoline motor. When not actually working, the motor is shut off, whereas with the steam type, steam must be kept up. The elimination of the upright steam boiler allows the driver a better view of his work and reduces the weight of the roller, without, however, reducing the pressure, besides insuring a more steady movement of the rollers.

A gasoline motor has eliminated the upright boiler, the steam and the noise of the street-roller of the older types

A Magician Among the Fishes

IT IS doubtless true that there are no mermaids in the sea and no Neptune with crown and flowing locks, but the species of life that do exist there are in many ways equally as interesting as the mythological folk. Take the little puffer fish, for example, which has attracted the attention of scientists from earliest times on account of its shrewd habit of defending itself by inflation. The moment it scents danger in the form of a larger fish, searching for a dinner, it instantly distends itself with water until it becomes almost spherical in shape, so that no ordinary fish could swallow it. Director H. C. Townsend of the New York Aquarium, placed a few good-sized scup, or porgies, in a tank which contained a dozen young puffers about two inches in length, which the hungry scup attacked at once. Instantly the baby puffers inflated themselves and became almost globular in form, so that the larger fish were unable to do more than knock them about like toy balloons too large to be swallowed, and on which they could get no hold whatever.

The putters are of many species, many of them reaching a length of about two feet, most of the larger kinds being found only in the large rivers of the tropics. When caught in nets and dragged ashore they inflate themselves with air just as with water when in the sea, making a slight sucking sound until their skins are as tight as drums. They remain inflated until thrown back into the water and can be knocked about on the beach like rubber balls without a particle of air escaping. Even when thrown back into the water they may float upside down for a time before assuming their normal shape.

A valve in the throat is the means by which this choice, edible fish is changed into an unmanageable balloon and back again when its fright is over.

The valve seems to be controlled entirely by the volition of the fish, unless the fright which the fish experiences upon

Above: The puffer in normal shape. There are numerous species, varying in size

Left: When inflated the puffers can be knocked about on the beach like rubber balls

A candle suspended from a wire shines through the stretched skin as through thin oiled paper making a bizarre lantern

sighting danger causes the valve to open spasmodically, thus allowing an inrush of water or air Sometimes the puffers die while still inflated, and they remain in that shape, being often driven ashore by the wind and dried on the beach by the sun

The Japanese make lanterns of them when they find them in that condition. They cut out the back and suspend a candle from a wire into the fish body, as shown in one of the accompanying illustrations which are published by courtesy of the New York Zoological Society. The light shows as brightly through the stretched skin as through a piece of oiled paper.

Some of the puffers are covered with spines which become rigidly erect when the skin is inflated. This species is also known as the sea porcupine. All the puffers have hard, strong beaks like parrots, which are well adapted for crushing the shells of the crabs and mollusks upon which they live. At certain times of the year, probably during the months that contain no "R," they are considered poisonous in the tropics, so much so that the gall of a Japanese species was formerly used to poison arrows.

A fragment of yareta showing the sponge-like construction of the interior in which resinous substance is secreted

The appearance of the yareta from a distance is that of a huge recumbent sheep

The Strange Vegetable of Peru That Resembles a Sheep

A CURIOUS plant growing in Peru is known to the native as "Yareta" or "vegetable sheep." It grows abundantly among rocks at high altitudes along the Andes of Bolivia and Peru, where it constitutes a conspicuous feature in the landscape because of its peculiar manner of developing the so-called "polster," or cushion formation.

The "yareta" forms hillocks or small mounds often three feet high and sometimes several feet in diameter. Moreover, the entire mound is made up of a single plant, not of a colony of individuals, and it attains this enormous size and extreme compactness by a process of repeated branching, so that the ultimate branches are closely crowded and the outer surface is continuous.

The flowers of the "yareta" are very thin, only about one-eighth of an inch long, and are borne in small clusters near the tips of the branches. The fruit resembles a miniature caraway seed. The natives use the plant as fuel.

A nearby radiator supplies the steam through a hose to the apparatus in use

Using the Steam Radiator to Remove Wall-Paper

TO provide a convenient means for utilizing live steam in order to make easy the removal of old wall-paper preliminary to redecorating, Julius Matzke, of Indianapolis, Indiana, has invented an apparatus which is said to meet all demands. The object of his invention, in addition to applying steam for the removal of the paper, is to localize the application of the steam so as to avoid injury to adjacent woodwork or other accessories, and to exterminate all germ and insect life on the wall.

The steam is supplied from a radiator and is led through a flexible hose to a hood-shaped head or steam-applying chamber. At the end of the hose, as it enters the hood, are numerous perforations which are staggered to distribute the steam as thoroughly as possible. A valve at the outer end of the pipe provides a conveniently located means for controlling the steam supply to the head. The hood may be detached and the nozzle used when working close to woodwork and for discharging steam into crevices to kill vermin.

A New Electric Cloth-Cutter for Small Shops

TO meet the demand of small tailor shops a cloth-cutter which cuts one, two, or three layers of cloth at a time has been designed. It consists of a compact and light machine which can be operated from the ordinary lighting circuit. It has been placed on the market by a western manufacturer.

Although electric cloth-cutters have been in use in large clothing shops for sometime, most of the machines heretofore employed have been made only in large sizes suitable for cutting twenty thicknesses of cloth at one time. These were not suitable for the small shop.

The new cutter is particularly adapted for the cutting of heavy cloth such as is used for overcoatings and the like.

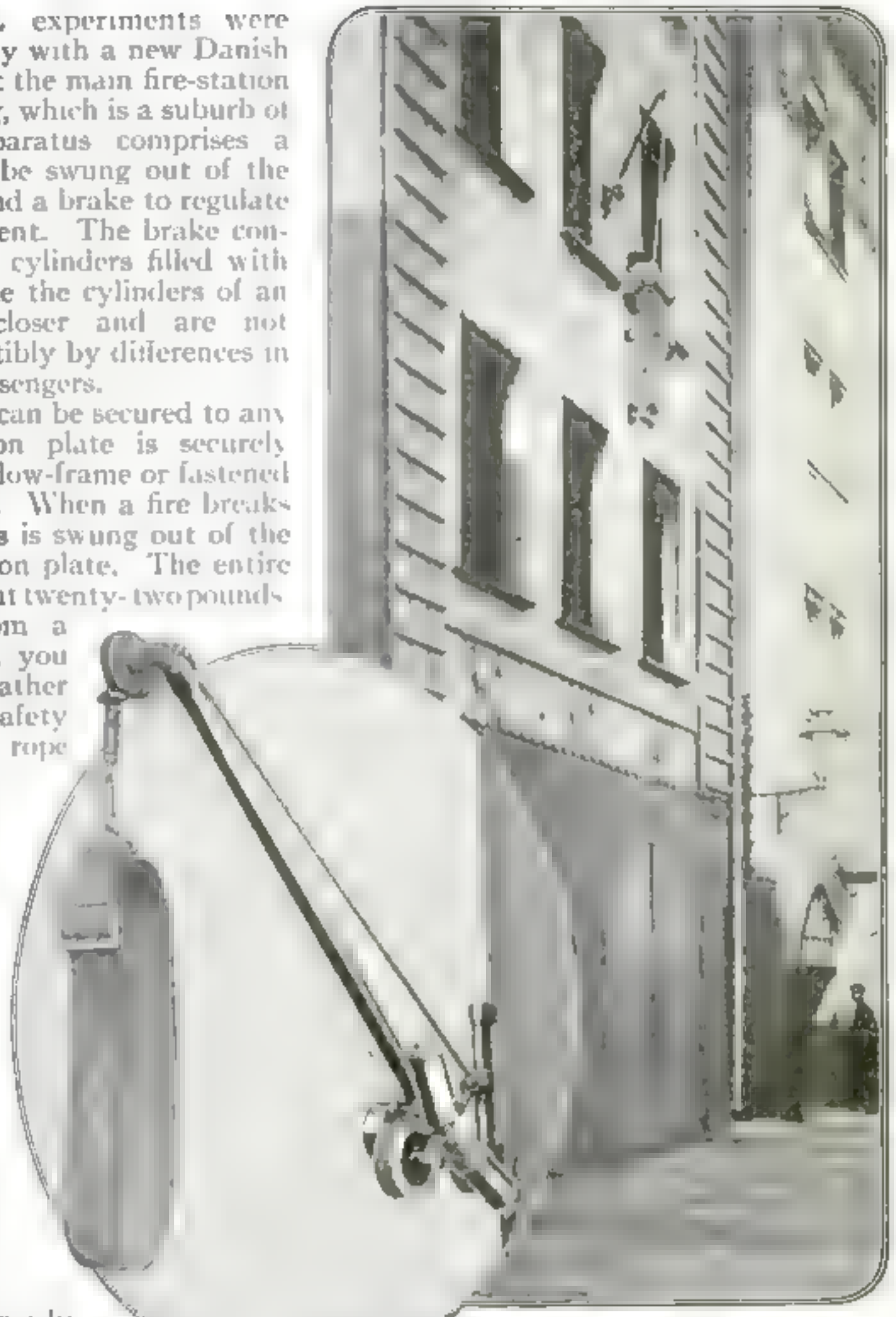
The cutter consists of a motor, a circular cutting-disk and an emery sharpening wheel

Dropping to Safety from a Fire

SUCCESSFUL experiments were made recently with a new Danish fire-escape at the main fire-station of Charlottenburg, which is a suburb of Berlin. The apparatus comprises a crane which can be swung out of the window, a rope and a brake to regulate the speed of descent. The brake consists of a pair of cylinders filled with oil. They act like the cylinders of an automatic door-closer and are not influenced perceptibly by differences in the weight of passengers.

The apparatus can be secured to any window. An iron plate is securely bolted to the window-frame or fastened to the stonework. When a fire breaks out the apparatus is swung out of the window on the iron plate. The entire weight is only about twenty-two pounds.

To escape from a burning building, you first put on a leather belt and slip a safety hook on the wire rope of the apparatus into a ring on the belt. Then you mount the windowsill, swing out the crane, and step into space. When you reach the ground, you slip off the belt. A coiled spring, which has been placed under tension as the result of your drop, winds up the rope automatically and is ready for the next passenger in line.



To escape from a burning building, a belt is put on, a safety-hook is adjusted and a swift descent is made through space

In the detail illustration the crane of the apparatus is shown and the brake cylinders which regulate the speed of descent. A coiled spring just above the belt rewinds the rope automatically

The speed of the drop is about three and one-half feet a second. The spring winds up the rope at the rate of seventy feet a second.

Experts are inclined to regard the new means of escape as the most efficacious yet employed. Besides being swifter than the old method it is considered safer and the exit is apt to be less frenzied than down a stairway.

The Electrical Scrub-Woman—Brainless but Efficient

The machine is fitted with four to eight brushes the pressure on which is regulated

IT IS only a matter of time before the scrub-woman will give way to the scrubbing-machine, just as the horse has given way to the automobile.

Scrubbing by hand requires physical strength and is slow and sloppy. There is nothing slow or sloppy about the mechanical scrubber.

The machine is fitted with four to eight brushes, which are regulated by an interlocking spider, so that the amount of pressure on the brushes may be adjusted according to the condition of the floor. The scouring soap-powder is carried in a can containing an agitator to stir the powder when the machine is in operation. Hence the powder is sprinkled evenly and not in cakes and lumps. The can is only four inches from the floor. Hand-sprinkled powder must drop about three feet.

The water-sprinkler is so placed that it applies the correct amount of water directly to the powder. The powder and water are immediately set in motion by the brushes.

After the floor is thoroughly scrubbed the dirty water is removed by means of a squilgee with a suction-pump so placed that when the squilgee gathers water the pump forces it from the floor to a can.

An electric scrubbing-machine with two operators will scrub three thousand square feet of floor in an hour.

Trundling Your Washing-Machine on Wheels

AMONG the most recent labor-saving devices for the woman in the home is a set of casters designed for use on washing-machines. Equipped with these the washing-machine is as easily trundled as a go-cart or other light vehicle.

The casters are easily detached by tilting the machine

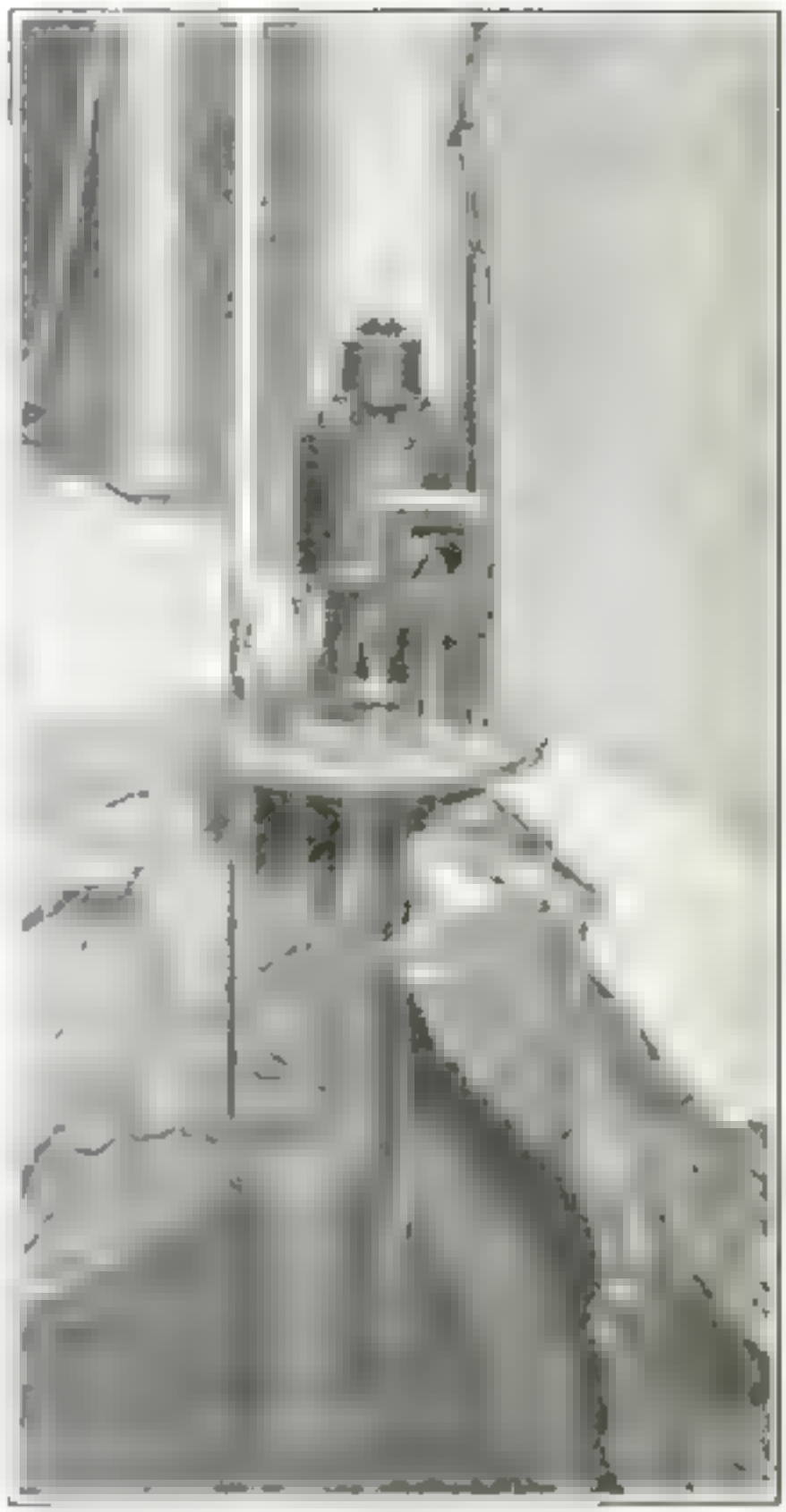
When the machine has been wheeled into the position required for work the casters are detached by means of tilting the tub first on one side, thus dismounting those on that side, and then tilting it on the other side to release the two opposite

A lever and notch are employed. Tilt the machine and the lever slips out of the notch. Lower the machine with a quick motion and the lever will slip over the notch so that the machine will rest firmly on its feet. When the machine is tilted and then lowered slowly the lever will slip into the notch, and the machine will once more be on wheels.

Small Electric Pump for Draining Seepage from a Cellar

HOUSEHOLDERS living on low ground are continually troubled with water seeping into the cellar. The condition is seldom easily remedied, for not even concrete floors and walls are successful in stopping the water's inroads. For cellars so afflicted a new electric seepage pump is proving highly effective. The idea is to make a tank-like hole in one corner of the cellar into which the water can seep in preference to working its way up through the concrete of the floor.

The motor used with this device has a vertical shaft, and is located on the cellar floor. The shaft is connected with a centrifugal pump under water in the hole beneath. The contrivance is entirely automatic in operation. A float sets the motor going when water has collected to a certain height and shuts off the current when a sufficient amount has been pumped out. The hole, being at a much lower point than the surrounding cellar floor, serves as a Mecca for all the ground-water beneath, leaving the floor dry and sanitary.



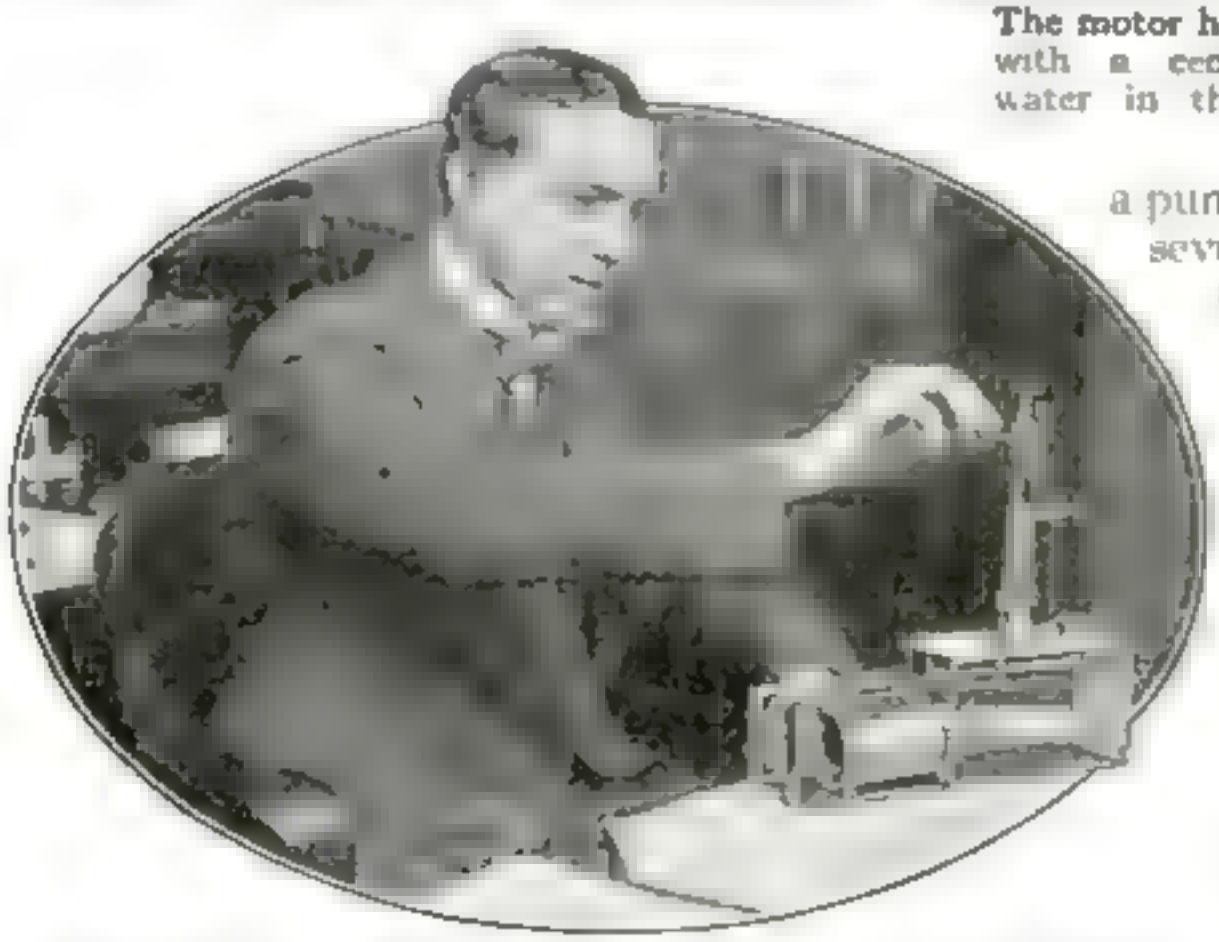
The motor has a vertical shaft connected with a centrifugal pump under the water in the hole beneath the floor

Pumping Up His Interest in Your Wares

THERE is no business man who can withstand a working model. With this fact as a basis for a sales campaign, a pump company has turned out several models of their gasoline tanks for use by their salesmen.

This picture illustrates a salesman demonstrating a pump to a prospect. The tank is filled with water, and by operating a lever the water is pumped out and a complete demonstration made.

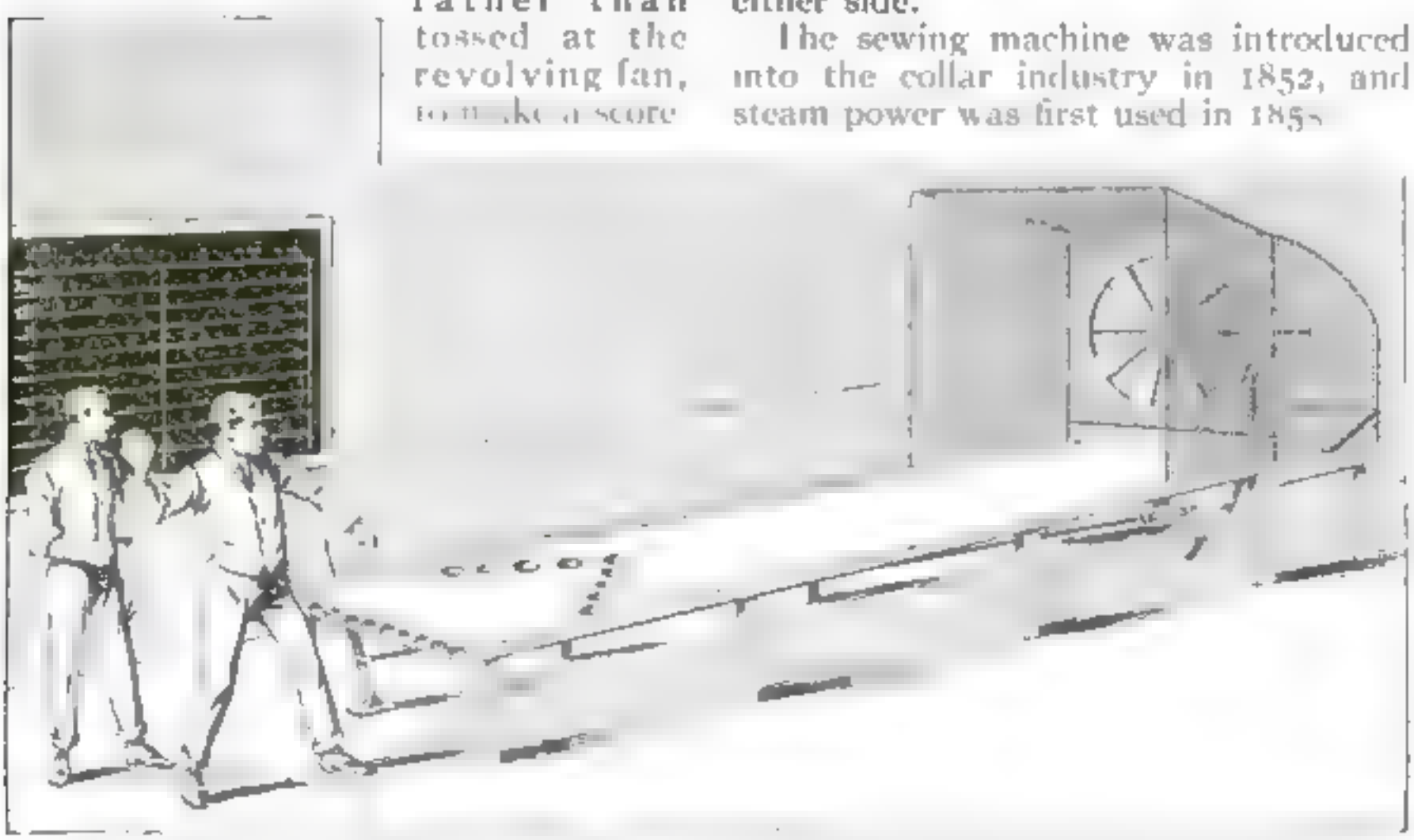
The usual plan of relying on arguments to convince the prospect does not compare in results with the model.



Many a sale is made by arousing the grown up boy's interest in a mechanical toy, getting him to watch how it works

Playing Ball with a Revolving Fan as a Target

A NEW game has been invented which makes it extremely difficult for an experienced ball-thrower to display his ability. Indeed, luck vies equally with marksmanship in running up a score. For instance, the player throws a ball at the target, which is made up of paddles or fingers held yieldingly in either active or inactive position. If the ball passes through and does not touch the paddles it rolls gently down the alley and into one of the high-score openings, generally one on the outside. On the other hand, if the ball hits the paddles it is deflected against the wire cage with such force that it rolls with considerable speed down the alley and thus into one of the low-score openings. However, there is nothing to prevent a poor shot from scoring high, which means that the inexperienced ball-thrower has an equal chance with the experienced. A novel feature of the device is that the score is constantly before the eyes and that the balls are returned to the thrower as fast as they are thrown. Of course, a person who can throw a ball with considerable force has a better chance of running up a high score than the person who cannot throw hard. The ball has to be thrown rather than tossed at the revolving fan, to make a score



The target is a fan composed of paddles and the object of the game is to throw a ball through the openings between them while the fan is revolving, without touching them

Where the Linen Collar Started and Who Started It

THE wife of a Troy, N. Y., blacksmith is said to have been the first person to have made separate collars for men's shirts. This happened in 1825 and men have been suffering ever since. Outside of inventing the separate collar this woman did the family washing.

Accordingly she set herself to work making separate collars for her husband's shirts and then made enough to sell outside the home. This innovation attracted the attention of the Rev. Ebenezer Brown, a retired Methodist minister, and he, with the aid of the women of his family, went about selling collars. This was in 1829.

All the work on these early collars was done by hand, for the sewing machine had not yet been invented. In those days not more than a dozen collars a day were sold. Their name—"string collars"—was especially appropriate, for they were tied around the neck with a string of tape attached to each end of the collar. Except the bands, the first separate collars were generally all linen and of two thicknesses, although some were faced with cotton cloth. They were slightly stiffened and had high points extending above the chin on either side.

The sewing machine was introduced into the collar industry in 1852, and steam power was first used in 1855

Motoring on Roller-Skates

IF we had wheels on our feet, something like the wings on Mercury's heels, would we "get there" much more quickly? Walking is admittedly an energy-consuming method of locomotion. A man's legs weigh forty or fifty pounds apiece, and the sheer labor of shifting them one ahead of the other means a considerable expen-

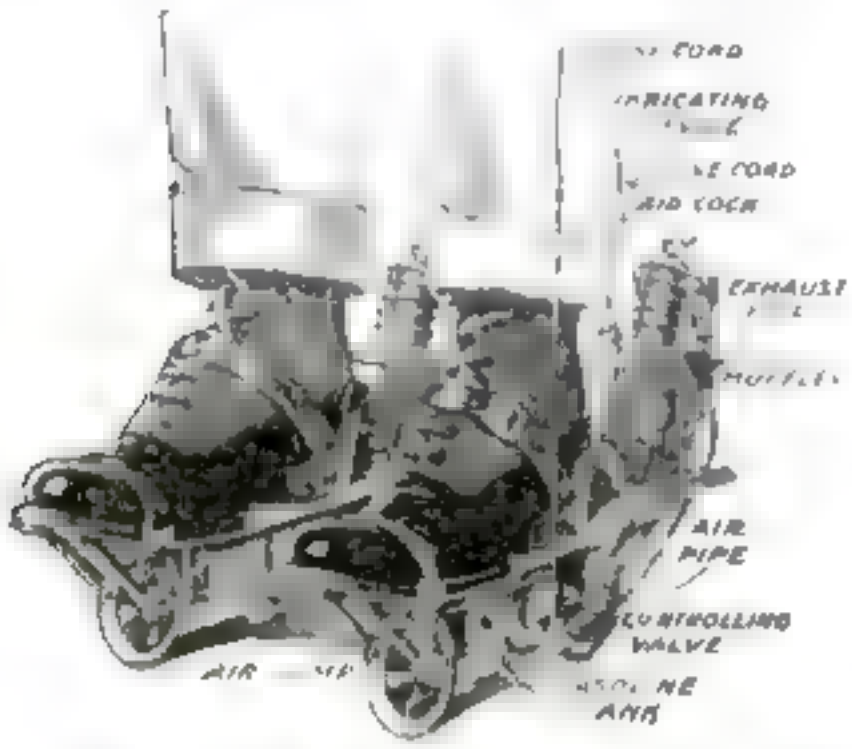


Fig. 1. The driving agency is a small gasoline engine in the rear of each skate

diture of energy. Placing the same weight on the respective pedals of a bicycle will convey a man much farther. Wheeled locomotion has time and again demonstrated itself to be the most efficient method of getting over the ground.

This leads up to the subject of roller-skates. Why is it they are not more in use? A man on skates can propel himself half a block with a stroke or two. Is there any reason why their use should be confined to children? Is it the dignity of the thing? Assuredly Americans never stop for dignity if a new contrivance will get them where they want to go faster than has before been possible.

Scores of different kinds of roller-skates have been invented. All the inventors appear to be striving toward an unattainable ideal, and each approaches the problem from a different angle. The ordinary four-wheeled skate such as children use is too tame for most inventors. They would make the vehicle self-propeling, apparently believing that therein lies the secret of the ultimate roller-skate.

The easiest way to make a skate propel itself is to put something on it to do the propeling. In some forms the driving agency is a small gasoline engine; mounted at the rear. (Figs. 1 and 7.) The machines have shaft or chain-drive and are complete as to detail, some of them resembling miniature Ford automobiles. They even have a gasoline tank under the instep and heel-part of the skate, the heel-brace being shaped somewhat like a miniature automobile seat. The great difficulty with the gasoline engines which must be employed is that the cylinders are so small. It is hard to get an explosive mixture into

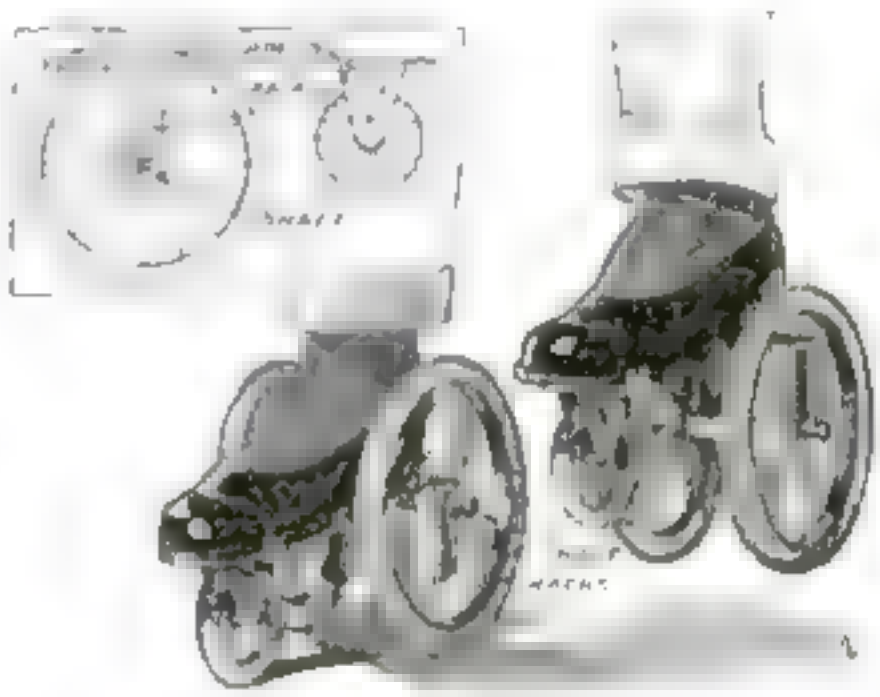


Fig. 2. A sort of pantograph-motion causes the rear wheel of this skate to revolve

them and to discharge the burnt gases. Consequently the engines are inoperative three-fourths of the time. Other self-propeled skates have been made along similar lines, but driven by an electric motor. These have, on the whole, been more successful.

The second general type is also self-propeling, but utilizes the weight of the rider in some way to supply the driving agency. The methods of doing this are legion. Most of them depend on the fact that a man raises his foot in taking a step forward. In swinging his weight onto this foot he exerts downward pressure on his heel. The skate shown in

Fig. 3 The spring on rear wheel must be wound up at each stroke

Fig. 10 has a rack-and-pinion arrangement to take advantage of this heel pressure. So also has the one shown in Fig. 3, but with greater complication, since a spring on the rear wheel must be wound up at each stroke. The spring keeps unwinding and is thus supposed to propel the rider at a steady gait. In the machine of Fig. 8 the rider's foot must incline at an angle with each forward stroke. The heel in descending makes a pawl catch in a cogwheel and thus drives the skate.

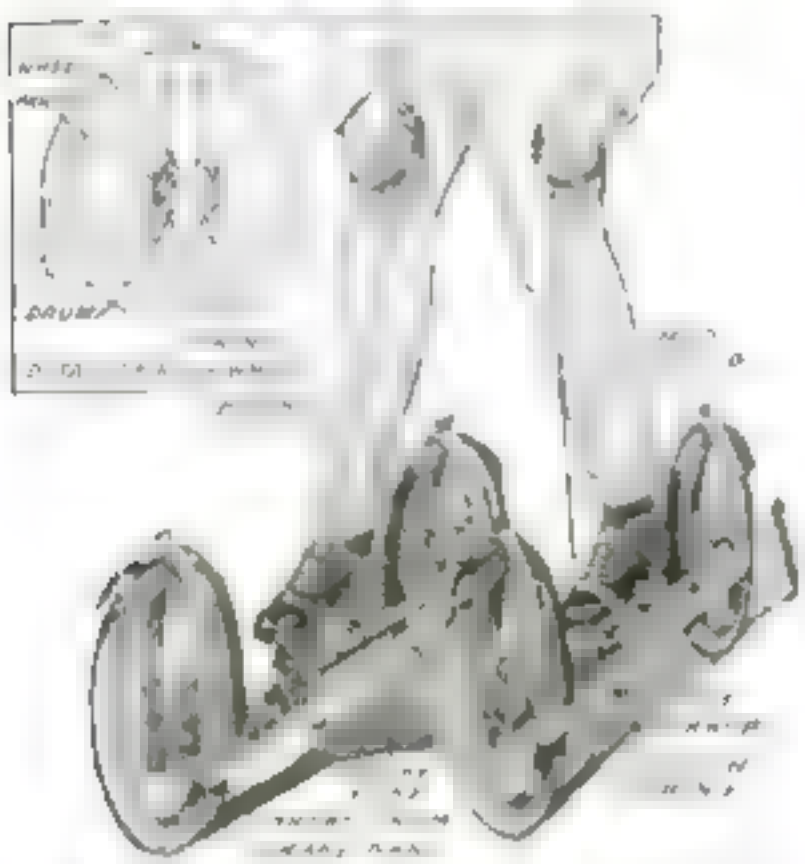


Fig. 4. Large wheels, a low center of gravity and a brake on the front wheel

It is impossible to get more power out of a machine than you put into it. The inventions discussed fail to allow for that fact.

The skate shown in Fig. 2 uses a sort of pantograph-motion. In descending the foot moves a lever downward. This engages a ratchet arrangement inside the hub and causes the rear wheel to revolve, thus driving the skater forward at a proportionate rate of speed.

All of the methods just mentioned are open to the objection that they use fine gearing at a point where great stress is imposed. Gear-teeth are likely to shear off under such conditions and the small bearings to wear excessively. However, the several mechanical movements are decidedly interesting for their ingenuity. The skate illustrated in Fig. 4 uses a ratchet and pawl at the rear hub but is operated by a long lever reaching to the center of the skate, to which lever the foot-rest is attached. This skate has large wheels and a low center of gravity—both desirable features. A handle just ahead of the foot-rest operates a brake on the front wheel through the medium of a connecting rope.

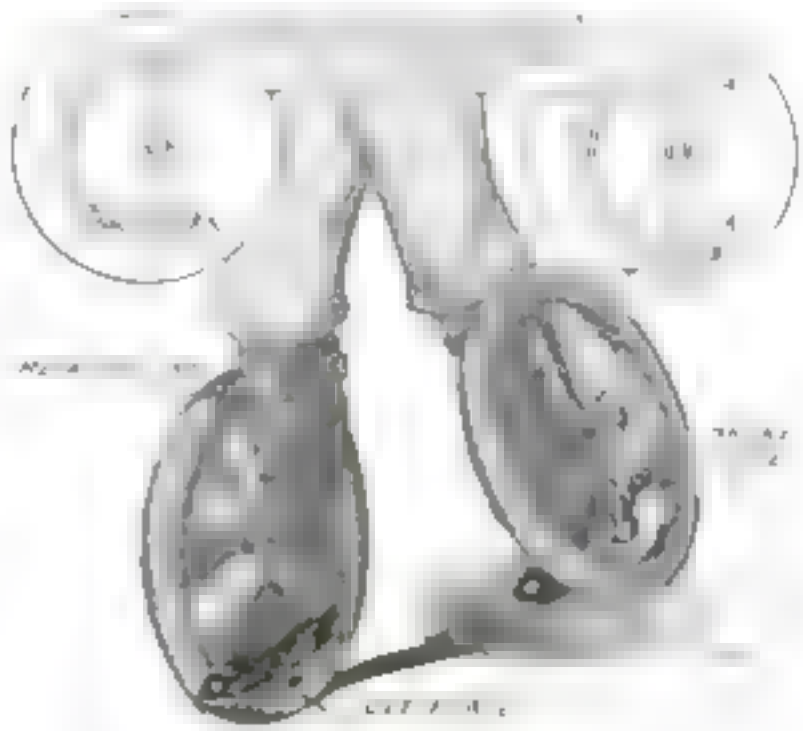


Fig. 5. A angle large bicycle-like wheel to be fastened to each of the rider's legs

Other skates are difficult to classify. For instance there is the one shown in Fig. 9, a kind of mechanical centipede. It has nine rollers per skate, arranged in single and double rows, the object of the single rows being to give more of knife-edge

Fig. 6. Skate propeled by taking strokes in the usual simple way

support when desired, as in an ice-skate. This is supposed to be of value in performing fancy evolutions. The axes of the rollers are not all in the same plane but follow a curve, so that by tilting his foot the operator can ride on any pair of rollers he likes. One wonders what would happen if a fat man unexpectedly struck a downhill stretch of slippery sidewalk. Sometimes simplicity, and even hard-running features are Heaven-suggested virtues.

Another skate (Fig. 6) is of the simpler sort. It is propelled by taking strokes,

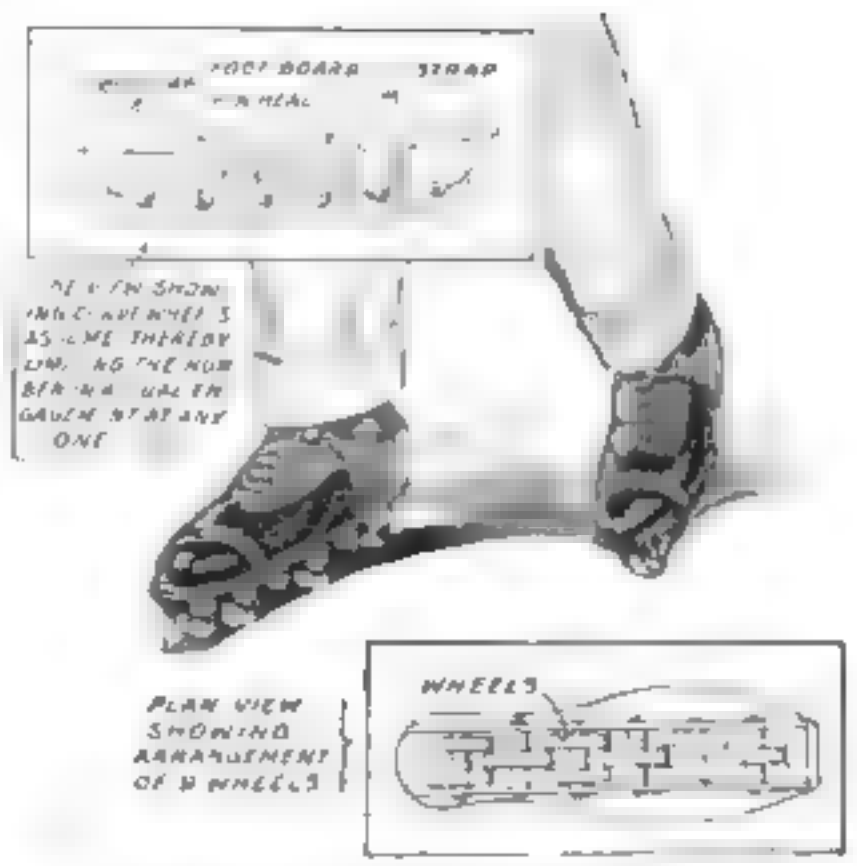


Fig. 9. A mechanical centipede with nine wheels arranged in single and double rows

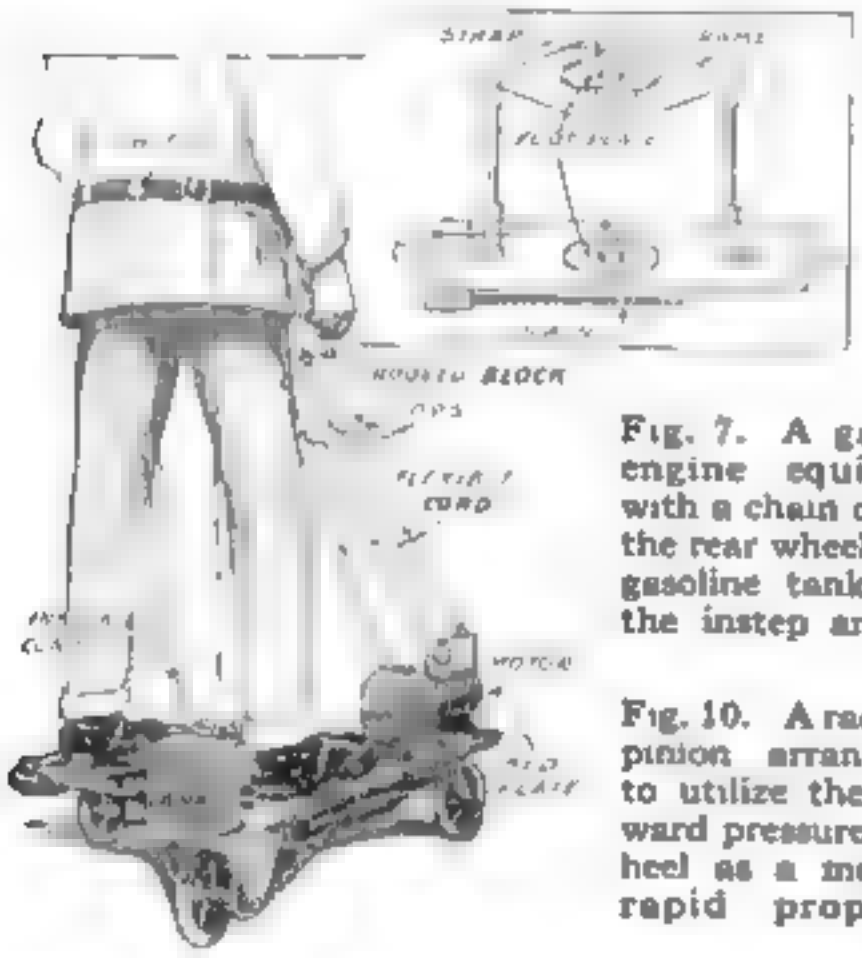


Fig. 7. A gasoline engine equipment with a chain drive to the rear wheel and a gasoline tank under the instep and heel

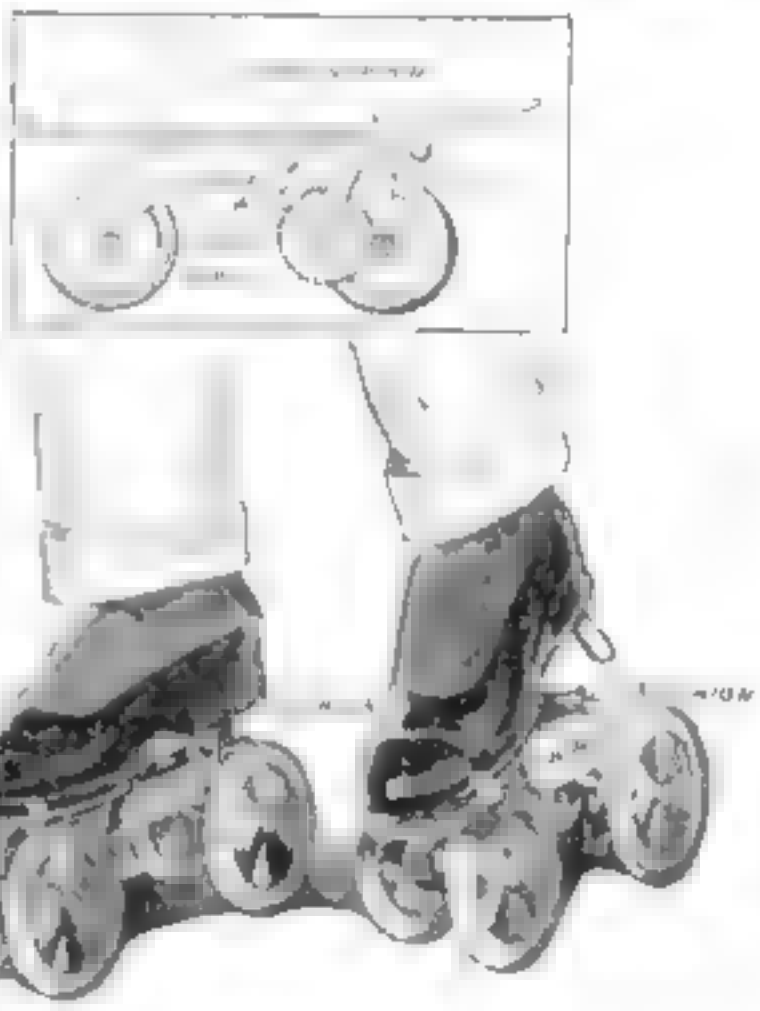


Fig. 10. A rack-and-pinion arrangement to utilize the downward pressure of the heel as a means of rapid propulsion

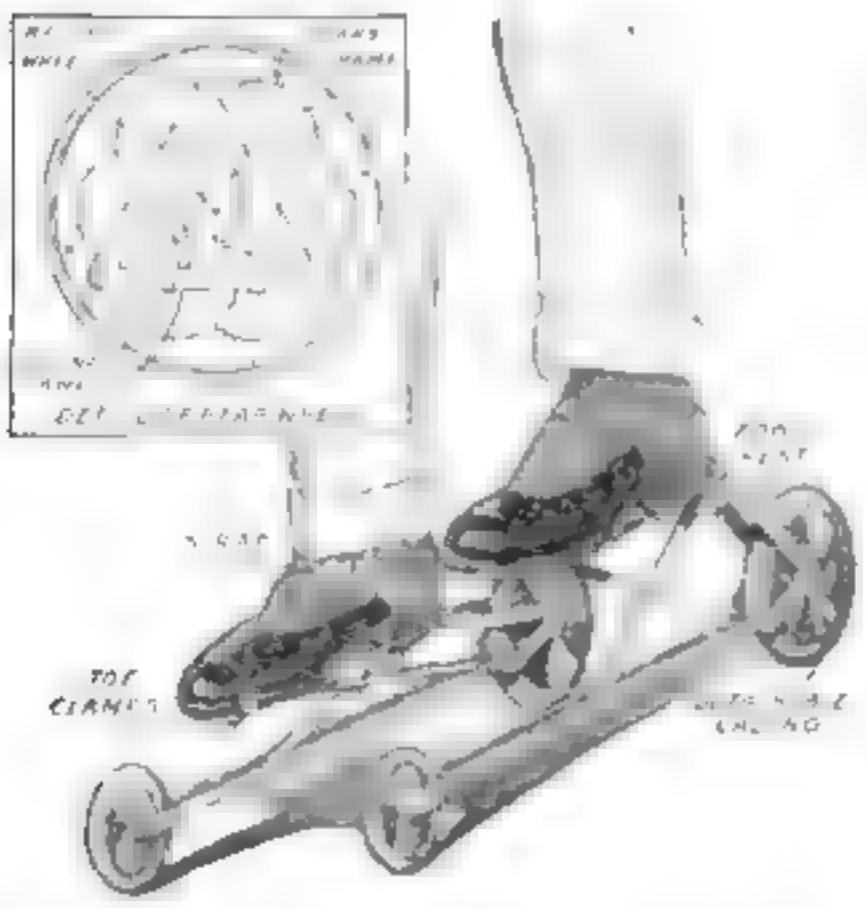


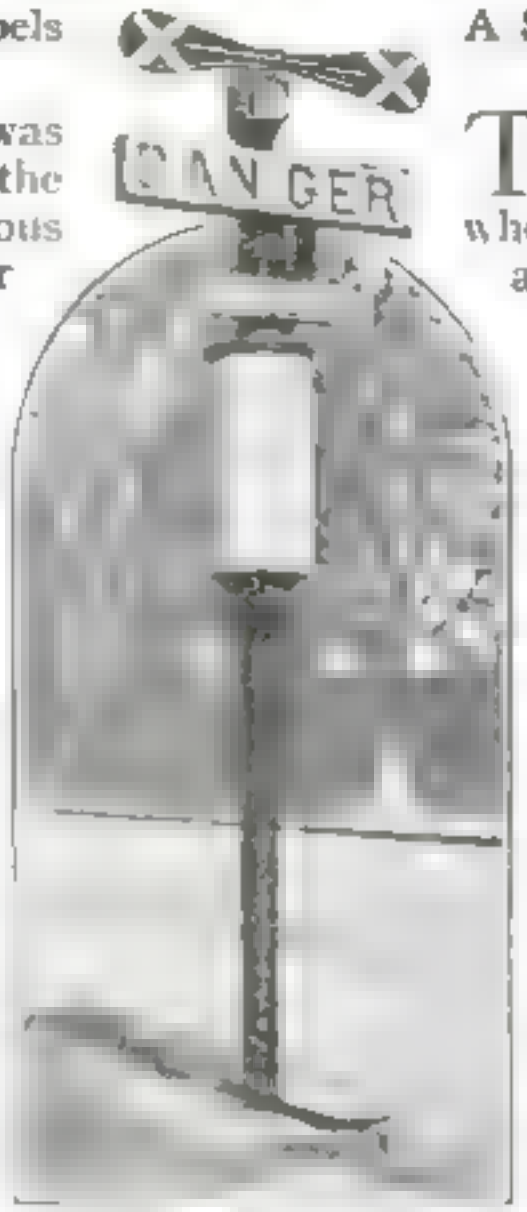
Fig. 8. The descending heel makes a pawl catch in a cogwheel and drives the skate

in the usual way. Skates somewhat similar to this are also made with four wheels each. Fig. 5 shows a type making use of a single, large wheel, fastened to the leg of the rider. By tilting his toe forward the rider can get a hold on the ground and thus bring about "energetic propulsion," to quote the inventor. The large size of the wheel makes it easy to ride over irregularities in the street. But the idea of proceeding down the street with a bicycle-like wheel strapped to each foot does not seem exactly conventional, either.

A Danger Signal Which Compels Attention

ONCE upon a time it was possible to stand on the corner of a reputed dangerous thoroughfare in a large city or even in the large towns and especially at railroad crossings and experience many of the thrills of melodrama at the narrow escapes of pedestrians and vehicles from accidents. But to-day so many precautions are taken and danger signals are so numerous and so cleverly planned that the number of accidents is minimized.

An electric signal has been designed for a dangerous corner where obstructions, such as trees and buildings close to the sidewalk or fences, shut off the view of approaching street-cars on a cross street from vehicles on the main street until it is almost too late to prevent a serious accident.



The brilliant colors and the revolving cross-piece cannot fail to attract

The cross-piece on top of the signal-post is connected by wire with a magnet over which the wheels of the car pass as it nears the corner. This contact of the wheels with the magnet sets the cross-piece in motion, and it continues to oscillate, flashing its brilliant colors insistently, until the car wheels have come in contact with a lever on the other side of the danger zone, the pressure upon which has released the signal wire. This serves as a reminder to the motorman to slow up as he nears the corner and as a warning to pedestrians and drivers of vehicles that a car is approaching.

At night the word DANGER shines out in illuminated red letters, the lights being enclosed in the box on which the lettering appears. A space is also reserved for the name of the crossing streets, making the signal-post a sign-post as well. The colors employed are eye-compelling, and the device has proved to be an efficient guardian of the public safety at that particular corner which has no traffic policeman.

A Safety-Bicycle for the Timid Fat Man

THE fat man who wants to reduce by bicycling but who does not want to fall off and injure himself in the attempt, can now ride with safety on a bicycle fitted with a new rear attachment which will prevent him from losing his balance.

The frame of the bicycle carries an extra pair of small wheels at the back alongside the rear wheel. When these are attached it is no effort to maintain one's balance. Moreover the new attachment makes it easier to mount and dismount.

The wheels are so small that they are scarcely noticeable to the casual observer. Besides the feeling of security which their perfect balance gives, they also share the weight.

How could any one fall off if his wheel is constantly propped up?

Removing High Lamp Bulbs

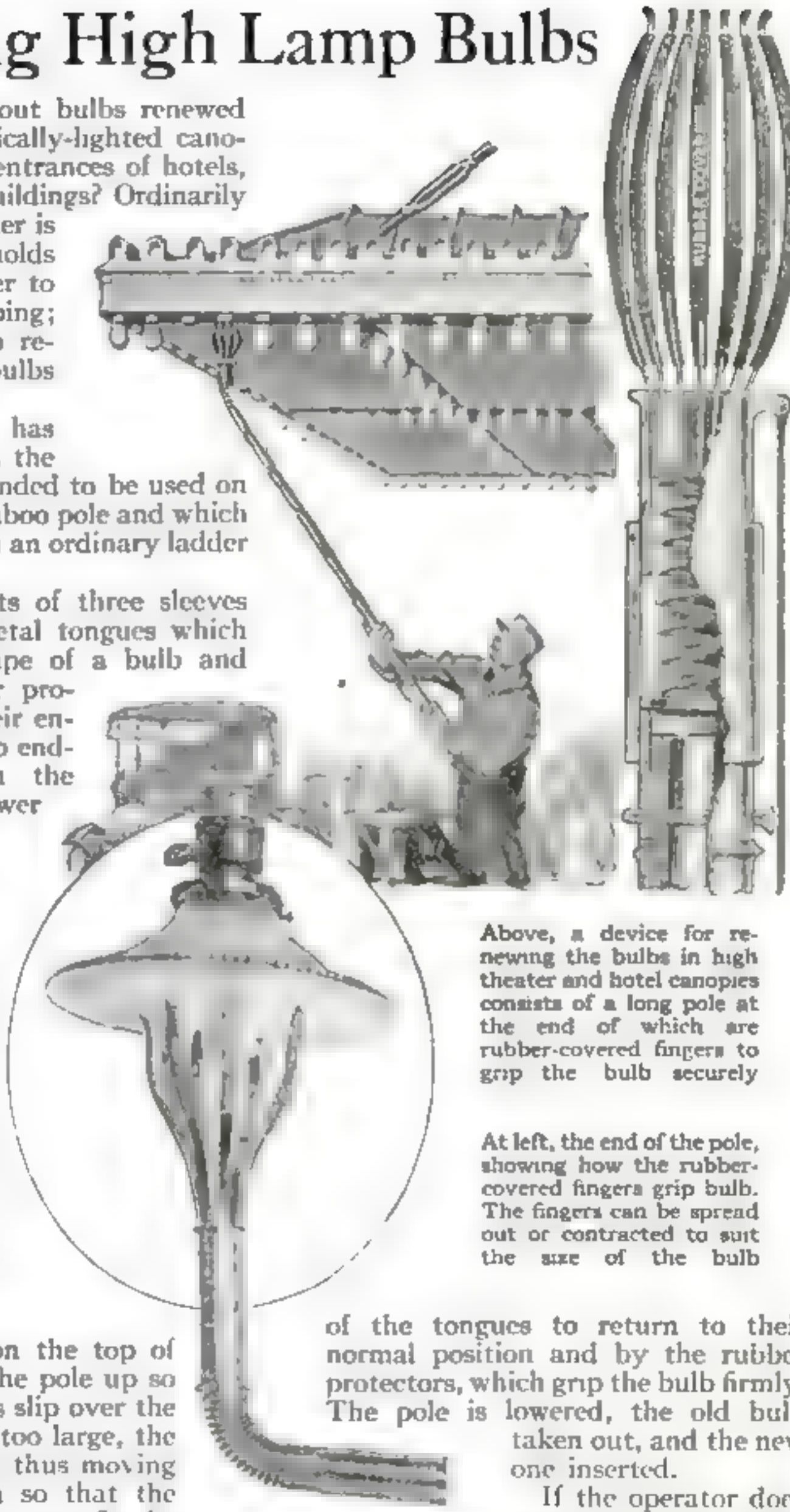
HOW are burnt-out bulbs renewed in large electrically-lighted canopies over the entrances of hotels, theaters and public buildings? Ordinarily a long extension ladder is required. A man holds the foot of the ladder to prevent it from slipping; another climbs it to remove the burnt-out bulbs and insert new ones.

A simple device has recently been put on the market which is intended to be used on the end of a long bamboo pole and which enables one man with an ordinary ladder to do this work.

The device consists of three sleeves carrying a set of metal tongues which are bent in the shape of a bulb and covered with rubber protectors for nearly their entire length. The two end-sleeves slide within the middle one. The lower sleeve is fixed on the end of the bamboo pole by means of a spread cotter-pin. The lower ends of the tongues are joined to a disk held in the upper sleeve and joined to the fixed bottom sleeve by means of a coil-spring. To a small eye-lug at the top of the upper sleeve a string is attached which extends down to the hand of the operator.

The man stands on the top of his ladder and lifts the pole up so that the bent tongues slip over the bulb. If the bulb is too large, the man pulls the string, thus moving the top sleeve down so that the tongues can spread out to fit the bulb. By turning the pole around screw-driver fashion, the bulb is taken out of the socket. It is prevented from dropping to the floor by the tendency of the tongues to return to their normal position and by the rubber protectors, which grip the bulb firmly. The pole is lowered, the old bulb taken out, and the new one inserted.

If the operator does not wish to move his ladder for each bulb to be taken out, he slides the middle sleeve down over the first one. The top sleeve and the tongues can then be bent to either side.



Above, a device for renewing the bulbs in high theater and hotel canopies consists of a long pole at the end of which are rubber-covered fingers to grip the bulb securely

At left, the end of the pole, showing how the rubber-covered fingers grip bulb. The fingers can be spread out or contracted to suit the size of the bulb

In Victor Hugo's "Les Miserables" Jean Valjean crawled through a sewer. An engineer in Pasadena used a motorcycle

A Six-Mile Trip Through a Sewer on a Motorcycle

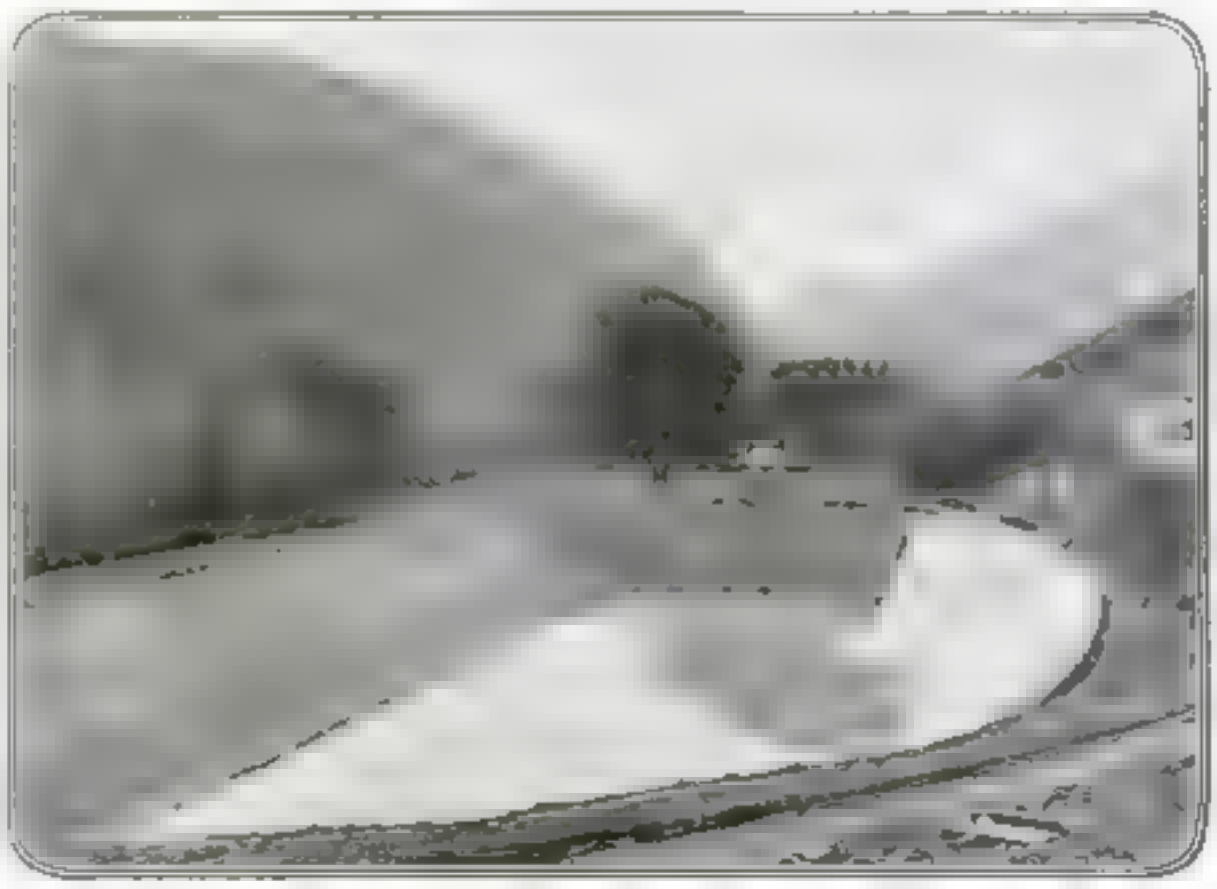
NOT since the fictional days of Jean Valjean has a trip through a sewer occupied so much space in print as the one made recently by the engineer of the newly constructed six and one-half miles of sewer at Pasadena, California. The trip was an inspection tour and was made on a motorcycle. To have walked the full distance would have taken several hours. So the engineer conceived the plan of lowering a motorcycle into the pipe at the clean-out hole in the beginning of the main artery and making a trip de luxe. He had never before ridden a motorcycle. Hence he chose one equipped with a tandem seat and selected an experienced driver.

A gas headlight on the motorcycle illuminated the passage. The distance was traversed in two hours, in spite of the numerous stops made to investigate walls and manholes. The only unpleasantness experienced was the noise of the motor exhaust, which was almost deafening on account of the narrow confines. Otherwise the plan worked perfectly, the headlight on the motorcycle making the passage as bright almost as daylight.

Transforming a Beauty Spot Into a Public Utility

THE water-works of Salt Lake City was recently augmented by the completion of the five-million-gallon Pleasant Valley Reservoir. This was obtained by the simple operation of lining with concrete an old pond. The cost was only $3,744 per million gallons. That the name—Pleasant Valley—is deserved is apparent from the accompanying view.

Nature is the great resource; she supplies the material. Man is the manufacturer. He transforms a mere scene into a public utility, yet preserves the beauty of the scene. The neglected pond had but one customer—Old Sol—while the concrete-lined city reservoir supplies water to thousands.

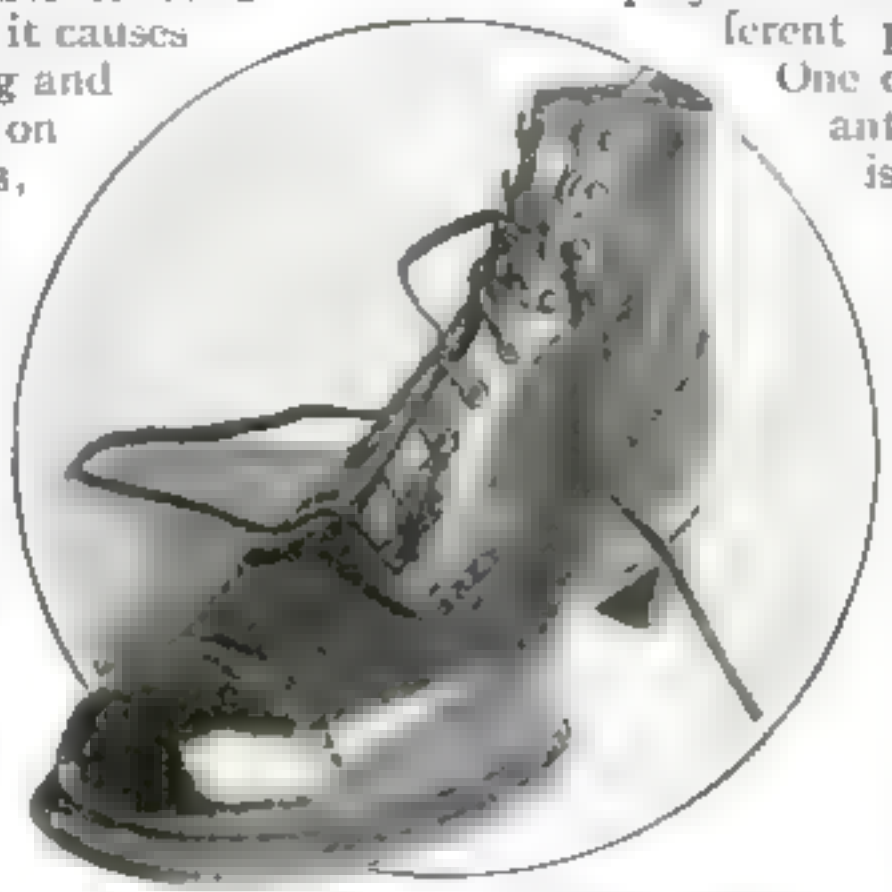


By lining a useless old pond with concrete five million gallons were added to the city's storage water supply

Why Isn't This Used Instead of Hooks and Eyes?

AN ingenious German invention for shoe-lacing is intended to take the place of shoe-hooks and shoe-eyes. The ordinary hook is liable to bend out of shape. Often it causes the shoe-lining to bag and press uncomfortably on the foot. Besides, threading the lace through many eyes is tedious.

The new device is a flat clasp on the surface of the shoe or boot. The clasp is made of the best spring steel. When the lacing is passed around it and the clasp snaps down it is hardly seen under the lacing. In an unlaced shoe the clasps spring up and stand away from the shoe, as can be seen on the top left side of the one in the illustration, so that there is no difficulty in bringing the shoe-string around the hook. By drawing the lace tight the hook is pressed down firmly on the surface of the leather. The leather then rises a little and covers the edges of the clasps. The new clasp does not lose its shape.



The clasps spring up and stand away from the sides of the shoe when unlaced

---

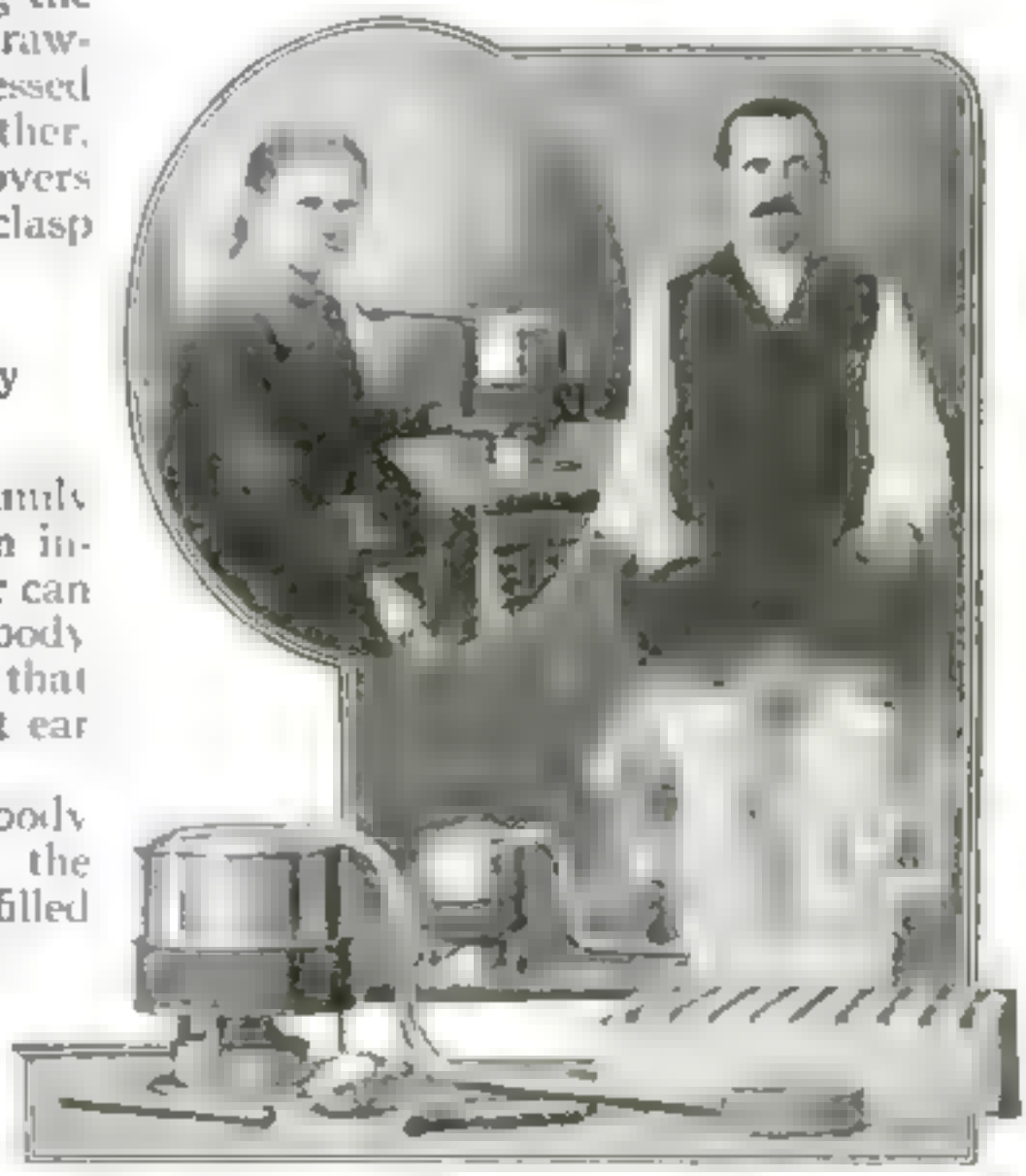
Steam Yourself and Drive Away Your Ills

A SMALL steam-generator for family use in case of illness has been invented by a German. His generator can be used to steam either the entire body or a single affected part, whether that part be your left foot or your right ear or any other member.

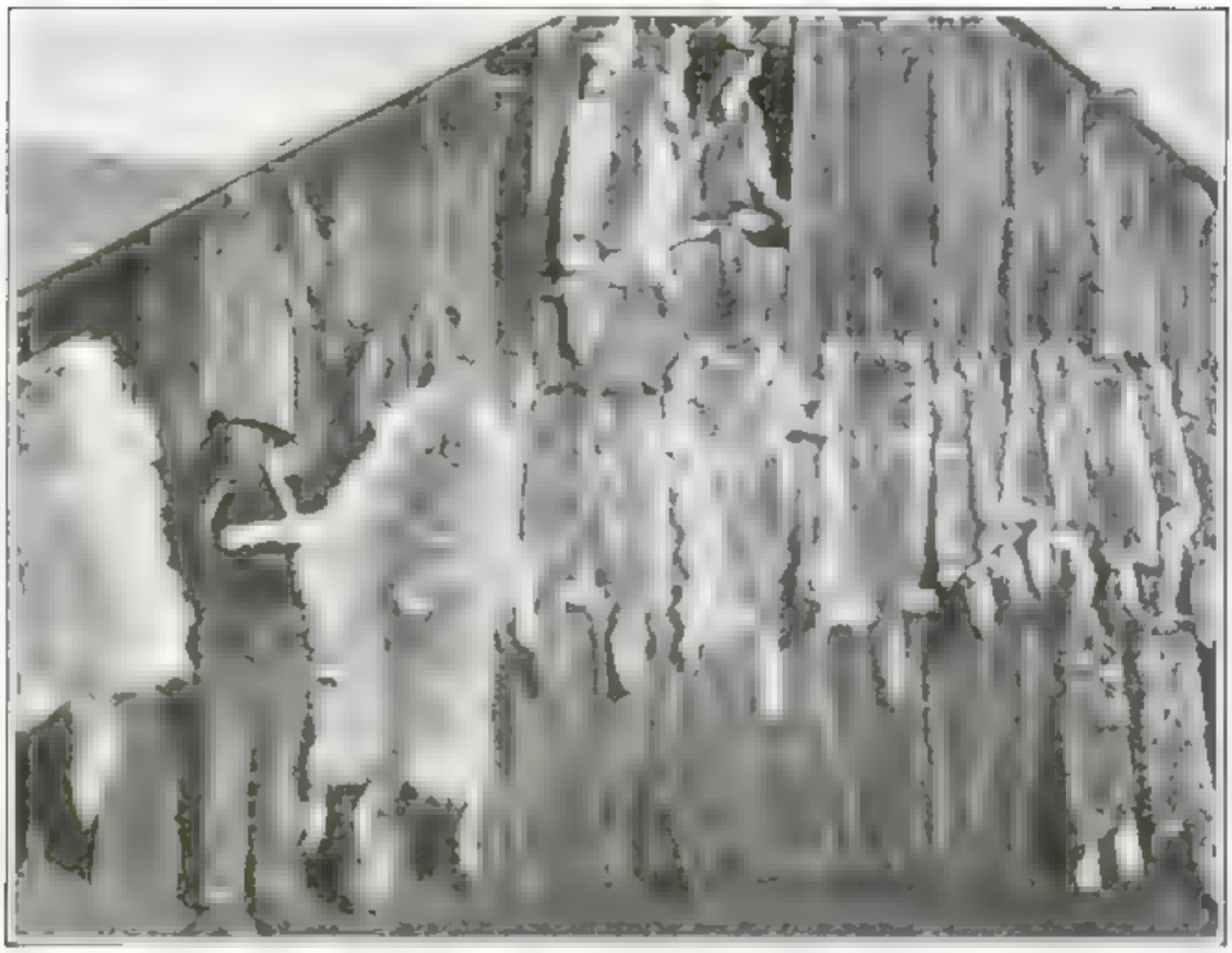
When a steam bath for the entire body is desired the kettle shown in the accompanying illustration is half filled with water. The shallow pan at the end of the connecting pipe is then set under the wooden slatting seen near it and the whole generator is placed close to a cane chair, when a bathtub is not used, after which the lamp below the kettle is lighted. The patient, seated comfortably, places his feet on the slats and envelops his entire body, except his head, in a covering which confines the steam.

A somewhat similar method is employed in the steaming of the different parts of the body. One of the most important uses of the generator is for a steam footbath in case of a sudden rush of blood to the head. The way it is used is plainly indicated in one of the illustrations.

The apparatus also gives excellent service as an inhaler for the throat or to steam the nose or ear. The equipment for such adjustment consists of a short, straight tube and a bulb, as shown in the upper left corner of the illustration. Three lengths of tubes are used.



The device may be used as an inhaler, or to steam the entire body or any separate organ



A catch made in the Gallatin National Forest, by an expert hunter of carnivorous animals. Coyotes are the most numerous, but wolves, bears, mountain-lions and wild-cats abound

Hunting Destructive Animals in National Forests

UNTIL the work was taken over recently by the Biological Survey under the provisions of an act of Congress, the systematic hunting of carnivorous animals in the national forests of the country was one of the tasks of the Forest Service. Expert hunters and trappers were employed for this purpose, and the accompanying illustration shows a catch made by one man in the Gallatin National Forest. In assigning the work to the Biological Survey, Congress provided an appropriation of $125,000 for this purpose.

Although private citizens have always been permitted to hunt in the national forests, carnivorous animals have at times abounded in certain of the Western reservations in such great numbers that their depredations proved a serious menace to stock-raisers. The hunters and trappers employed by the Government devote their entire time to shooting and trapping, and many pelts are obtained by them. Coyotes are the most numerous of the carnivorous animals on the majority of the reservations, and wolves, bears, mountain-lions and wild-cats abound in the order named.

How the Firing of Heavy Guns Affects Animals

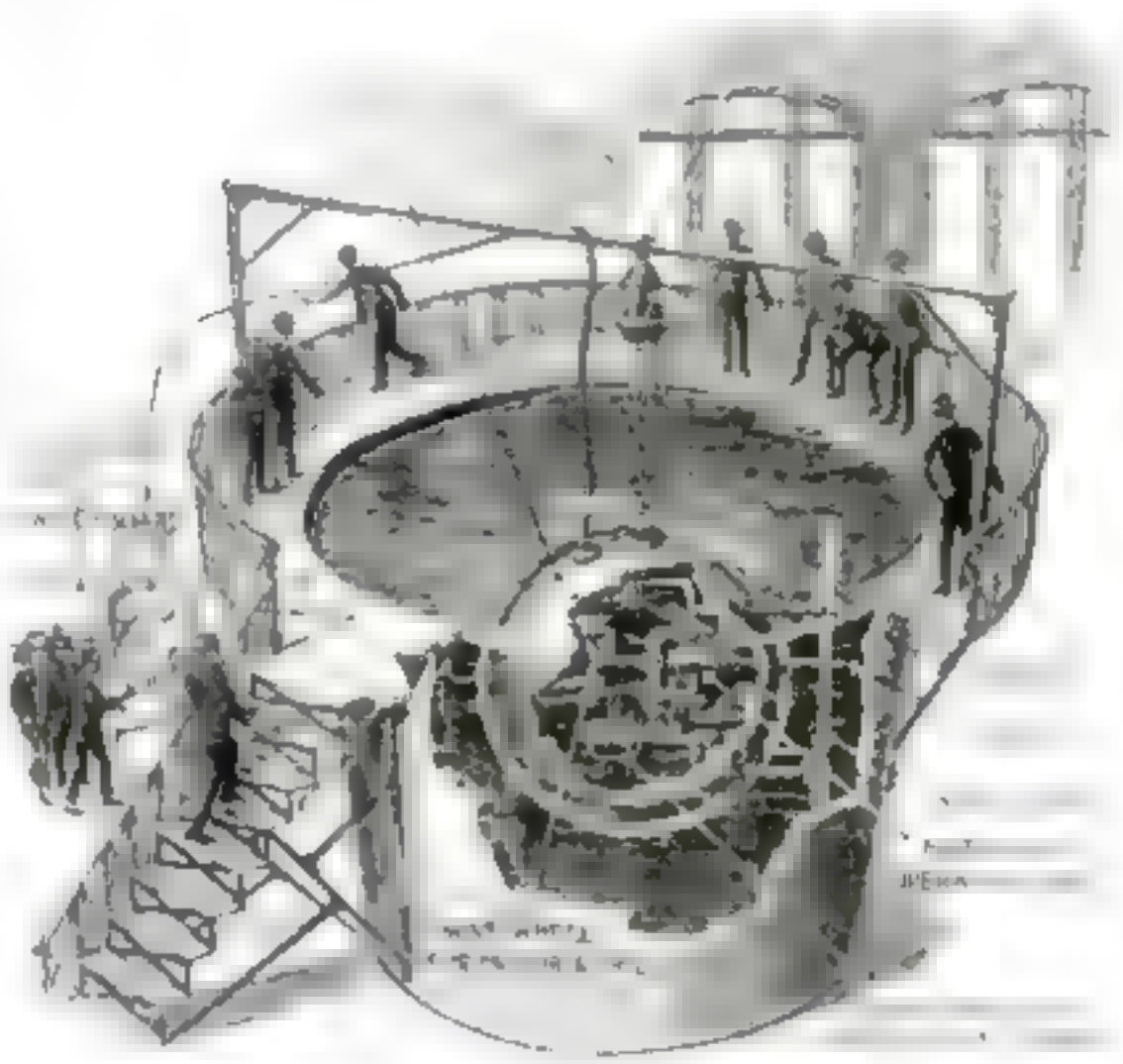
A GERMAN veterinary surgeon has made some curious and interesting observations upon the psychological effect produced on animals by the firing of big guns. He considered the horses and dogs used for military purposes, and the game in the area of warfare. Soon after the war it was noticed that large numbers of horses and especially dogs migrated into countries beyond the seat of hostilities. The wild boar, the badger, bear, red deer and roebuck followed, but strange to say the hare, whose timidity is proverbial, refused to leave its home. Birds which remained unfrightened were owls, falcons, sparrow-hawks and crows.

A Machine-Shop in a Diving-Bell

A DIVING-BELL in a large steel tank filled with clear water was exhibited in a New York store recently. The tank was fourteen feet in diameter and ten in height.

Suspended from a stanchion overhead was an iron sphere about four feet in diameter. It hung from the stanchion by chains and could be raised or lowered by means of a triple expansion block and tackle. A stout, well insulated electric cable ran into the sphere and disappeared over the rim of the tank to a strange-looking switchboard. Protruding from one side of the ball and equally distant were four powerful electromagnets. The flat surfaces, or "heels" of these were parallel. Facing them was a thick steel plate suspended in the water. From the external switchboard, electric current was sent through the cable and into the electromagnets. They exerted a pulling force of four tons each which drew them and the sphere to which they were rigidly fastened, against the steel plate. The steel plate represented the steel side of a sunken ship. Another switch was thrown on, and a half-inch steel drill which protruded from the sphere between the four magnets commenced to turn until it penetrated the steel plate. Another switch was thrown on. The drill withdrew from the hole it had bored and wormscrews commenced to revolve which shifted the position of the ball slightly, and in a very few minutes another hole was drilled.

Under actual working conditions, this sphere would be used to carry two men to the sea bottom, who would attack the side of a sunken steel or iron ship exactly as the miniature sphere attacked the steel plate in the diving tank. In the demonstrating apparatus, the stanchion represented the sea barge from which the hollow iron ball carrying the two workmen and their equipment would be lowered to the depths in the vicinity of the sunken ship, through the sides of which holes would be drilled as the first step toward raising it to the surface for salvaging.



The steel plate in the tank represents the steel side of a sunken ship through which holes will be drilled for grappling hooks

When sufficient holes were drilled strong hooks would be inserted to which would be attached pontoons. When enough hooks had been inserted and enough pontoons attached to them, the water would be pumped from the pontoons from above. The ship, theoretically, would rise to the surface, and could then be towed without further difficulty to the nearest dock.

While the miniature apparatus performs admirably, the "life-sized" diving sphere has not yet been given a trial.

A Fleet of Indoor Battleships

One of the ships was mounted on a motor-truck and accompanied by six navy officers it made a two-weeks' tour through New York city recruiting men for the navy

TO TRAIN its officers and men in fleet evolutions and to teach recruits the nomenclature of a battleship, eight miniature warships have been so constructed by the Second Battalion of the New York Naval Militia that they can perform on an armory floor all the maneuvers of a battle fleet at sea. With the hulls cut off at the water line and with the ships mounted on wheels located inside where spectators cannot see them, they look like real battleships.

Each ship is operated by men seated within its interior so that their heads come under the forward fire-control masts. From the exterior they are invisible, concealed as they are by the bridge and by weather-cloths through which peep-holes are cut. Two men supply the motor-power. They sit under the superstructure and work hand-levers connected by gears with the forward wheels. From the steering-wheel to an axle aft run tiller ropes. The axle carries a loose wheel on either end and swings freely on a vertical shaft so that when the helm is put over, the stern swings to starboard or to port.

Night practice with the fleet of eight miniature warships is carried on in the armory with all lights extinguished. Equipped with running lights, search-light, trucklights and Ardois signal system, all supplied with current from storage-batteries, the ships make their way about the armory floor in any formation that may be desired. They make a picturesque spectacle maneuvering in the dark with the aid of their signal lights, the flagship of the little fleet blinking its instructions to those in line behind it, and one after the other repeating the orders.

Large classes of naval men or recruits are often seated in the galleries where they watch the fleet in action and listen attentively to an official explanation of what is taking place. The exact movements of a division of ships are carried out by the same signals as at sea and the ships form column, line, echelon, turn and countermarch with remarkable facility of movement, affording practice which primes the men for the annual summer cruises.

The ships were constructed under the direction of Commander Kingsley L. Martin by the Chief Gunner's Mate of the Battalion, William H. Free, and his assistants at the armory, in Brooklyn. In addition to its value to the Naval Militia, the fleet has interested the general public. At one of the reviews given by the men, at which time the public was invited to a demonstration of the duties and activities carried on by the Naval Militia, about five thousand people saw for the first time how a fleet

of battleships is maneuvered in cruising and battle formations. The visitors were shown how a night blockade is formed. One vessel lighted up a harbor entrance with its searchlight, while the others cruised around on circular blockade with all lights out or very closely screened.

Only recently, as if to demonstrate the versatility of these little ships, one of the eight was placed on a motor-truck and with six navy men from the recruiting office standing at different positions on the deck, the motor-truck made its way through New York city, stopping at corners to give a man an opportunity to address the large crowds which never ceased to gather.

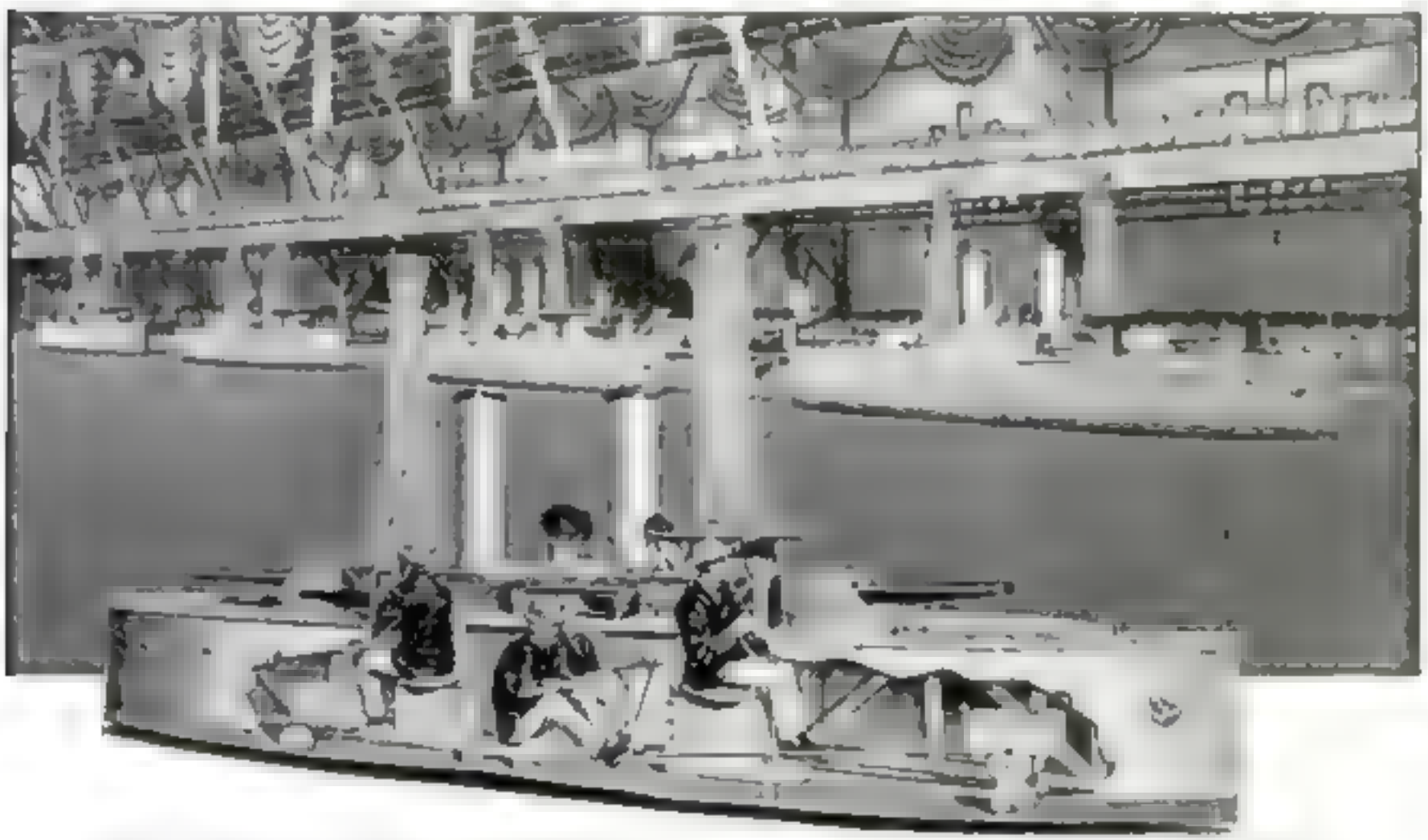
The truck with its cargo and its crew carried on its unique method of recruiting for two weeks. During that time the number of recruits increased noticeably.

The ship mounted on the motor-truck shown in the illustration is a model of the Connecticut. It is twenty-six feet long and five feet wide. The turrets are eight feet above the deck, and were so high that the truck could not get under the elevated road structure without first cropping off nearly a foot of its height.

Detecting Enemy Submarines from a Ship's Look-Out

THE present war has demonstrated that effective measures can be taken against a submarine attack by maintaining an efficient look-out. The great difficulty has been that with the best of binoculars and telescopes the movement of the ship constantly disturbs the observation.

To overcome this difficulty, John Gardner, the inventor of the Gardner submarine signaling system, has devised a method by means of which the observer seated with his telescope supported on a stand can be certain that his finding instruments will always be parallel to the surface of the sea, regardless of the rolling and tossing of the ship.

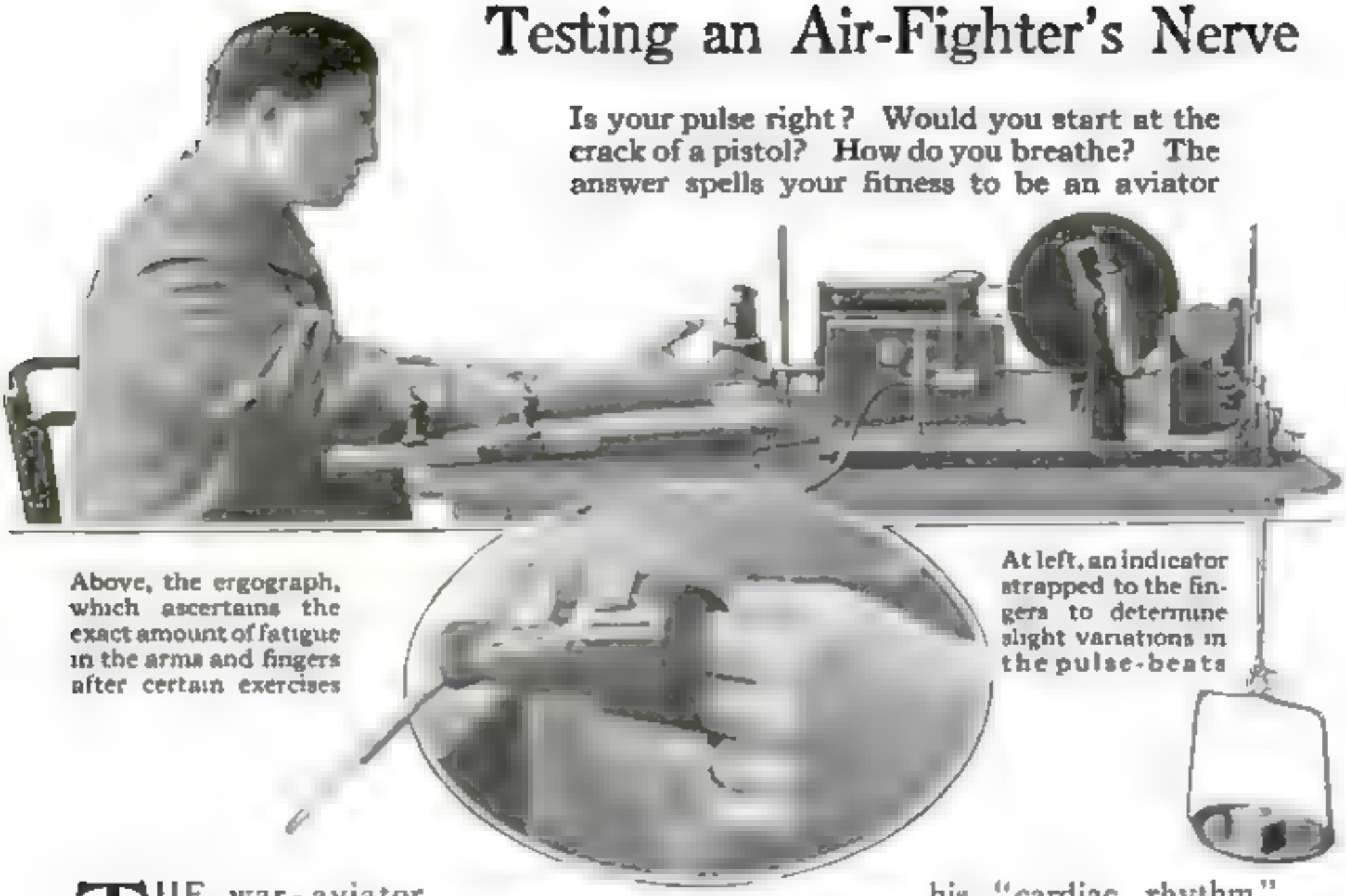


Men concealed within the ship's interior operate hand-levers which move it about on the floor in any formation desired. Each ship is equipped with a complete signaling system and with running lights, searchlight and trucklights for night practice

He achieves this end by mounting a pedestal securely to the deck, and on this a seat with a table to support the telescope on a standard. By the operation of a gyroscope the seat and table are maintained in a position parallel to the sea surface. Furthermore, the platform with seat and table is rotated from left to right by the gyroscope, so that the observer need only concern himself with keeping a sharp look-out over his field.

Testing an Air-Fighter's Nerve

Is your pulse right? Would you start at the crack of a pistol? How do you breathe? The answer spells your fitness to be an aviator



Above, the ergograph, which ascertains the exact amount of fatigue in the arms and fingers after certain exercises

At left, an indicator strapped to the fingers to determine slight variations in the pulse-beats

THE war-aviator must be so constituted that the sudden menace of danger, of shells bursting about him, of machine-gun bullets raining upon him will find him calm and collected. He must face a crisis not only with deliberate calm, but with the ability to escape with a whole skin.

Polo-players, lion-tamers, big-game hunters proved to be the best aviators in the early days of the flying-machine, simply because they were so constituted that they were not appalled by danger. Indeed, they courted perils. Men of this rare type are hard to find. Besides, every man obsessed with the daredevil spirit does not necessarily constitute the ideal aviator. Even timid business men have their moments of reckless daring. What is wanted is the stuff of which Daniel Boones and Shackletons are made.

But in addition to the daredevil spirit, has the prospective aviator muscular and nervous endurance? After clutching for an hour the control-levers of a speedy monoplane, is his hand firm, or does it tremble? After witnessing a terrible accident, is his heart-beat, his "cardiac rhythm" undisturbed? Is his respiration still normal? Moreover, are his nervous and muscular systems so well balanced and so nicely correlated that his hands promptly obey every external command?

These important questions must be answered in his favor if he hopes to get a job as a war-flier with the French army. The French do not want daredevils to drive their air-machines if they are daredevils and nothing more.

For the purpose of finding out just how favorably every applicant can answer these difficult questions—and he can not answer them with his lips—the French war department employs an ingenious testing machine. Psychologists have known and employed what is called the d'Arsonval chronometer for many years. But it is unlikely that the delicate mechanism has ever been put to such an interesting task.

One part of it tests the pulse-beat. Another determines the tremor of the nerves. Still another registers the respiration. Another apparatus discovers the ability, or the inability, of the applicant to withstand fatigue. After he has

undergone several simple examinations, the candidate is seated in a chair and the final, supreme test is applied.

How would most men act if a revolver were discharged unexpectedly behind their ears? The answer is simple. They would leap into the air; their heart-beat would probably double; they would gasp and tremble as if they had palsy. In so doing they would promptly disqualify themselves as aviators in the French army.

In testing the possibilities of an aviator, various contrivances are attached to the body, all having a definite purpose. Tubes lead from these devices to a slowly rotating cylinder, on which paper is wrapped. They terminate in points which record the slightest variations in his physique.

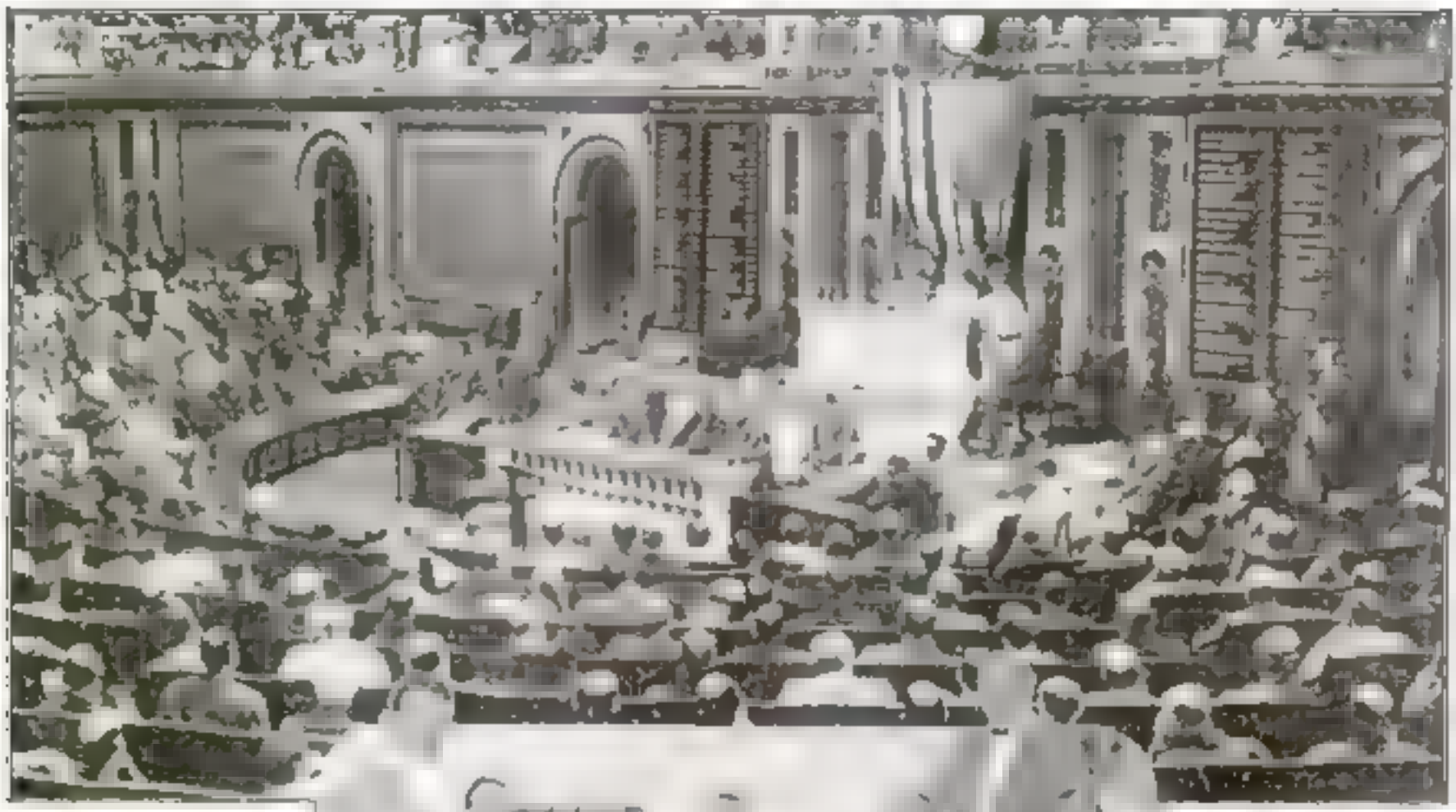
When the clockwork has started and he is perhaps wondering what the queer apparatus is all about, a deafening explosion takes place a foot behind him. The record made at that moment on the revolving paper determines whether or not he is to become a French war-aviator. If his heart-beat, his respiration and his arm nerves and muscles show no undue excitement on the paper cylinder, he goes to work. But if the stylus actuated by his pulse-beat dances about the rotating sheet, he is disqualified. It is only natural that his reflex nervous system should respond in some way to this sudden stimulus; but the man who tests him knows how wide a variation from normal may be tolerated.

Next in importance to the revolver-shot test is that which ascertains the candidate's promptness in acting upon an external command. For example, he is told to press an electric button when he feels a light touch on his left ear-lobe, or when he sees a light flash. His quickness in acting upon these sensations determines whether or not he could meet the sudden contingencies which occur in the air. In a word, whether or not he could handle his 'plane over a roaring battlefield without losing any part of his nerve.

The jagged line on the chart shows the breathing before and after the explosion, indicated by the cross

The d'Arsonval chronometer which records on a smoked paper cylinder the pulse-beats, respiration and nervous tremors of the applicant when a pistol is fired behind him

A Voting Machine for Congress



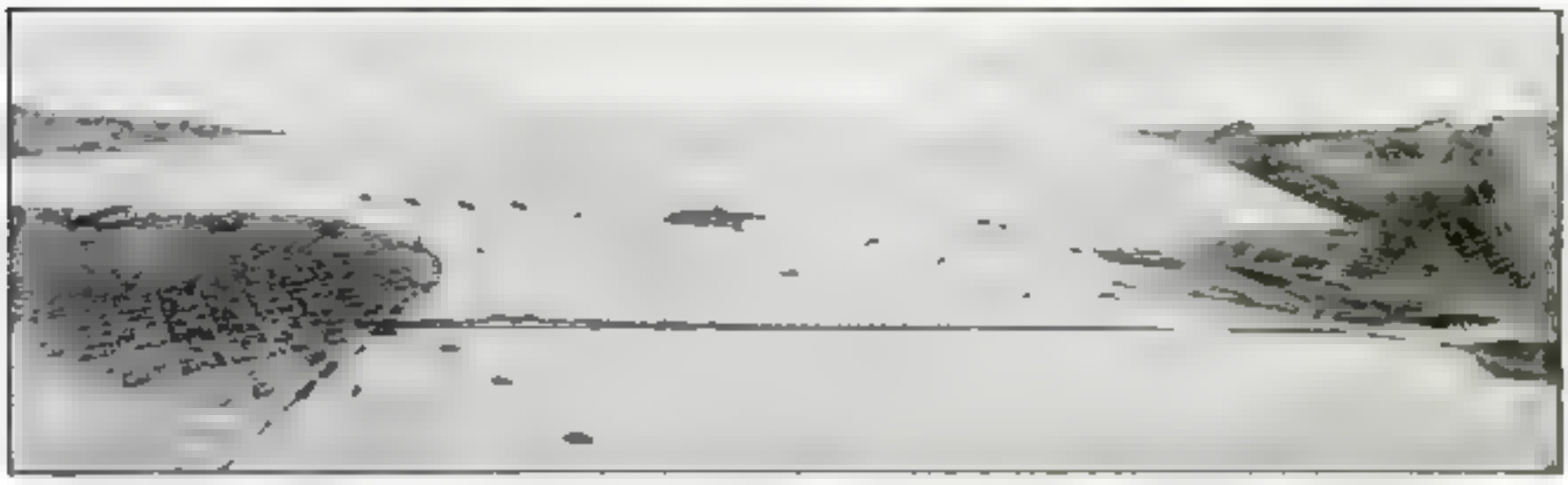
Above: How the two large registering boards of the mechanical voting system would look if they were installed in the House of Representatives

At left: The mechanical voter reduced to a demonstrable size with batteries and connections for a committee examination. It is really a form of telegraph with many keyboards

FOR nearly a century, inventors, spurred on by the deplorable roll-call system in use, have devised instruments of one sort or another to enable Congress to register its vote in a few minutes instead of in the forty to forty-five minutes which are consumed by the roll-call. In each case it has been conclusively proven that a mechanical system of voting would not only greatly economize time, but would also effect a large saving in money. And yet, there is no mechanical voting system in use. If there was it would kill filibustering on votes.

During a long session of Congress a mathematician figured that fifty-six days had been consumed in roll-calls alone. A voting machine, which is now being considered, has taken ninety thousand roll-calls. It would give Congress two hundred years' work to call the roll that many times. The inventor, Bornett L. Bobroff, of Milwaukee, Wisconsin, has installed his system in the State Legislature of Wisconsin, and it is giving excellent service there. In a single session of Congress he says he can lop off thirty days' work by calling the roll with his machine.

Each member votes by pressing a button on the desk in front of him. He and everybody else can see how he voted, as his vote duplicates itself on a large board within the view of all. The board also totals the vote automatically. In the event that a member wishes to change his vote he merely presses another button provided for that purpose and the total of "yeas" and "nays" is accordingly corrected on the board.



The bridge will be erected over the shortest distance between the central shores of San Francisco and Oakland, the bay there being very shallow and beyond the busy shipping district

A Bridge Five and One Half Miles Long

SAN FRANCISCO is planning to build the greatest bridge in the world. It is to connect Oakland and its contiguous districts with San Francisco, and is to relieve five ferry systems of passenger and vehicular traffic.

The proposed bridge will cost twenty-two million dollars and will be five and one half miles long. It will be one of the heaviest bridges ever built, carrying three roadways and four railroad tracks. Its main portion is to be made up of sixteen spans each two hundred and fifty feet long. Near the San Francisco shore there will be two long and high spans under which the ships will pass.

The bridge will be a double-deck structure. Three roadways will extend along the upper deck and four railroad tracks along the lower deck. Its capacity has been made great enough to provide for traffic for many years. It will have two tracks for overland passenger trains, two tracks for electric trains, and three separate roadways.

Fanning Yourself with the Rocking-Chair

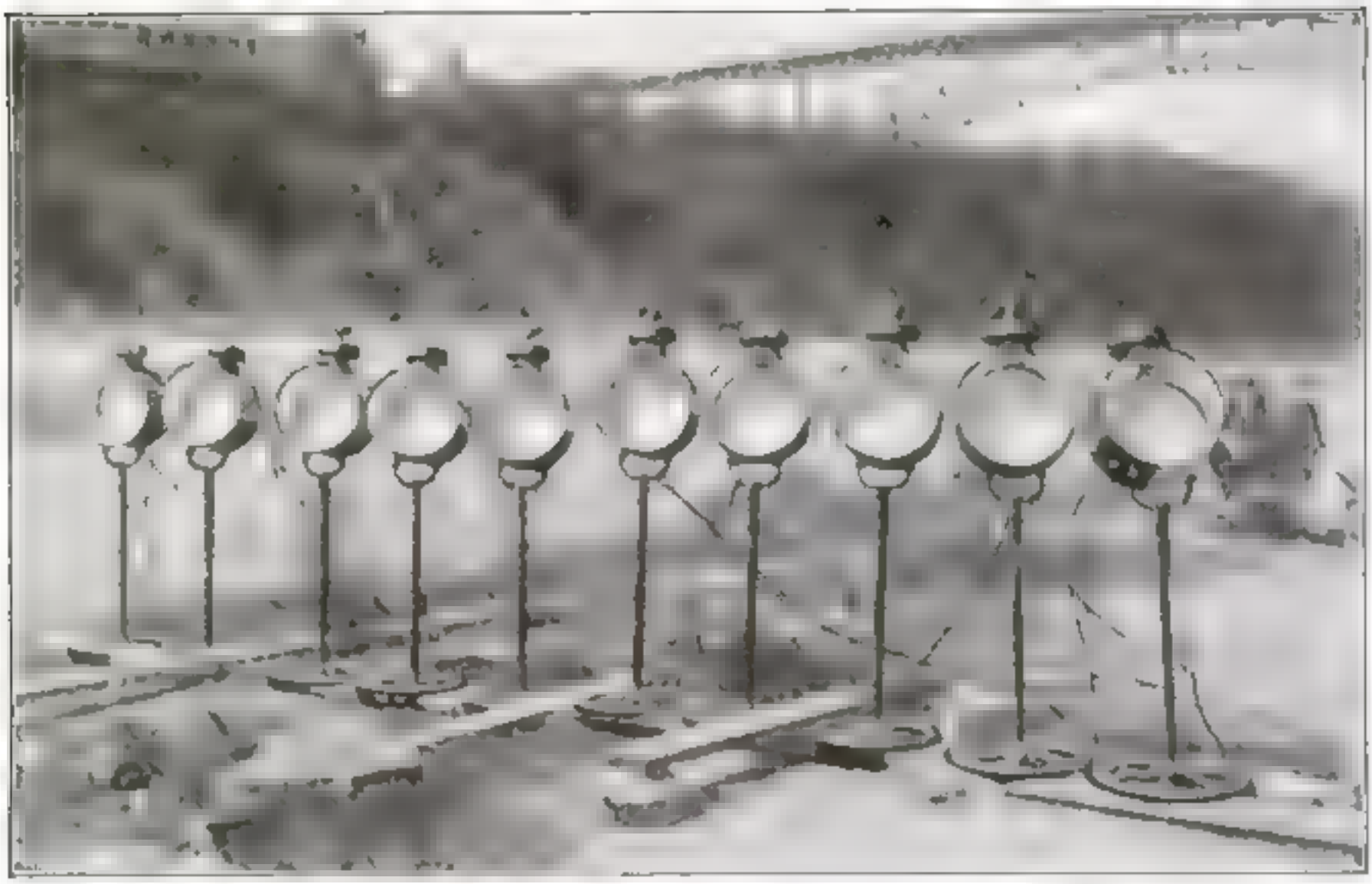
EVERY time you sit in the family rocker and move yourself backward and forward you are unconsciously wasting energy. Why not use the energy? Dozens of inventors have asked themselves that question. Charles H. Towers, of Philadelphia, has answered it by making the rocker drive a fan at the rate of four hundred and fifty revolutions a minute.

The accompanying illustration shows a young lady fanning herself by rocking the chair in which she sits. The fan, mounted on a pedestal at the right elevation for a good breeze, is connected by a flexible shaft with a gear-wheel, which, together with an operating lever resting on the floor, can be attached to any chair-rocker.

A gear-wheel with a small pinion attached to a flexible shaft imparts the motive power of the chair to the fan

The operating mechanism consists of a casing with a gear-wheel affixed to an arm which travels over the floor on a small roller. As the chair rocks the arm tilts up and down, thus rotating the gear-wheel. The gear-wheel meshes with a small pinion attached to a shaft.

Flood-Lighting Niagara Falls



A battery of incandescent lamps which play upon Niagara's waters. With these lamps Niagara is to be brought out of the night and bathed in electric radiance

ILLUMINATING Niagara Falls at night by artificial sunlight is the ambitious scheme now occupying the attention of prominent engineers and the officials of Niagara Falls, New York, who have authorized an expenditure of ten thousand dollars for the project.

For several nights a battery of twenty-five flood-lights was turned on the American Falls and the rapids of the Niagara River, to the great delight of thousands. Indeed, the effect was so successful as to exceed the expectations of the promoters. It is now planned to double the number of lamps in service and from time to time to enlarge the battery as new lighting effects are desired.

In illuminating the waterfall at night the light is projected from an ingenious patented reflector, which spreads beams of pure, yellow light which very closely resembles sunlight upon the curtain of falling water and mist. An artistic realistic effect is produced, which would be unattainable by any other means. With this system of flood-lighting, receiving its power from the Falls themselves, there is no dark center or wing-shadow in the light beam. The Falls are smoothly and softly lighted. On the other hand, the beam is powerful enough to penetrate the densest parts of the rolling mist.

Strange as it may seem, the Falls are thus illuminated not by electric arcs, but by incandescent lamps. This achievement was made possible by the gas-filled lamp, remarkable for its renewing properties. It is a one thousand-watt one hundred and ten-volt tungsten lamp, which is filled with an inert gas, such as nitrogen or argon. Such lamps are now competing successfully with arcs in street-lighting. The reflectors used at the Falls are as true parabolas as it is possible to make them commercially, and they give a powerfully concentrated beam of light rated at one hundred and fifty thousand candlepower in the center of the beam, when used as a flood-lamp, and as high as five hundred thousand candlepower when they are employed as a searchlight.

Artificial Sunlight to See Niagara by Night

Niagara as a night attraction. When the installation is completed the Falls will be illuminated by artificial sunlight from one hundred and thirty incandescent lamps arranged with such skill that their soft rays will not reveal their hiding-place

Testing the Lifting Capacity of Balloon Fabric

THE accompanying photograph gives an accurate idea of the great strength of balloon fabric. Six men are shown in a basket suspended from a balloon patch. In the ordinary balloon there are twenty such patches, which means that the huge gas-bag is strong enough, considering only its fabric, to bear the combined weight of one hundred and twenty men.

The photograph is interesting from another angle. It shows how the ropes are attached to the fabric. The ends of the ropes are first separated into four strands which are frayed out and sewed to the fabric after which another layer of fabric is cemented over it. The basket is designed to accommodate two persons, yet the combined balloon patches have a lifting capacity of more than ten tons.

There are twenty patches in each balloon

The Night Eyes of the Coast Artillery

IN ORDER that the coast of the United States may be guarded by night as well as by day, the officers of the Coast Artillery have developed a type of searchlight larger than any hitherto used in the United States Army. The one illustrated is located at Fort Terry on Plum Island, where the United States maintained a military camp for boys this summer.

Guarding the entrance of the sound there are fifteen such searchlights. Under favorable conditions the beam from one of these giant searchers can "pick up" ships at a range of ten thousand yards, or almost six miles. Under ordinary conditions its range is about seven thousand yards. The light itself consists of the barrel, which is a large horizontal cylinder, in the back of which is a great parabolic mirror which measures sixty inches across. The front of the barrel is closed by plate glass. Between the glass and the mirror an arc plays between two horizontal carbons, capable of developing eighty thousand candle-power. The carbons are fed automatically and last for about five hours when the light is in steady use.

Each searchlight, a unit in itself, is mounted on a truck, by means of which the light may be moved to various points. A motor operating the moving mechanism of the light is connected electrically with the controller which may be at any distance from the light.

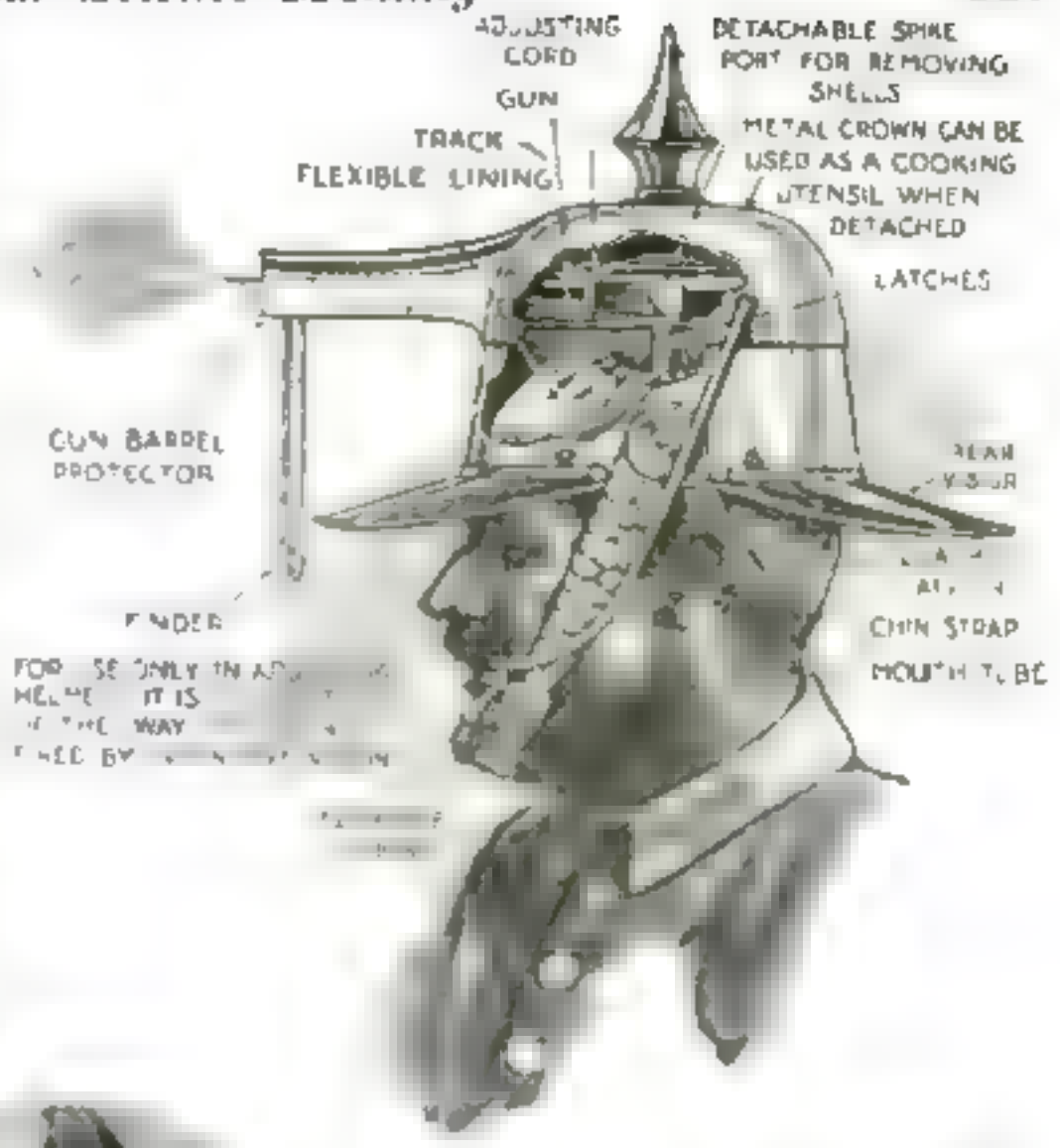
By means of this arrangement an officer in an observation tower may manipulate the light in any direction desired by using a series of levers.

Under favorable conditions the beam from this giant searchlight can "pick up" ships almost six miles distant

A Peaceful-Looking Hat Which Makes You a Walking Arsenal

"HANDS UP!" is not such a disconcerting command after all, provided one wears the hat shown in the accompanying illustration. When the highwayman gives directions as to how he would like to have you hand over your valuables, you look him calmly in the eyes and then shoot him by simply blowing a tube passing from the mouth to the trigger of the gun mounted in the top of the hat.

Several cartridges are provided in the magazine, so your aim need not be perfect. Furthermore, the recoil from the explosions will not unseat the hat. It cocks the hammer for the next shot and ejects the used shell. The cartridges are automatically fed to the breech of the gun



The gun is aimed by turning the head and fired by blowing through the tube in the mouth

The suit is provided with numerous tubes through which air passes to the wearer

and when the magazine is empty the trigger can not be operated. A new magazine is then substituted by removing the hat. The gun is aimed with the turning of the head and by blowing through the tube a bulb is expanded which trips the cocked hammer, exploding the cartridge. When detached from the base of the helmet the crowned section may be inverted and used as a cooking utensil, the elongated hood serving as the handle.

Mechanical Lungs for the Protection of the Fire-Fighter

A SMOKE-MASK suit has been devised which operates on the principle of the human lungs. Two tubes supply the wearer with oxygen from a tank carried in a pocket attached to the suit, one for the mouth and the other for the nose. The suit is provided with numerous air-circulating tubes connected with the nose. The mouth exhalations are carried to the tank and come in contact with the purifying oxygen before the air is again breathed.

The United States Army's first armored car has twenty port-holes for machine-guns and a well in the center for a three-inch rapid-fire field piece

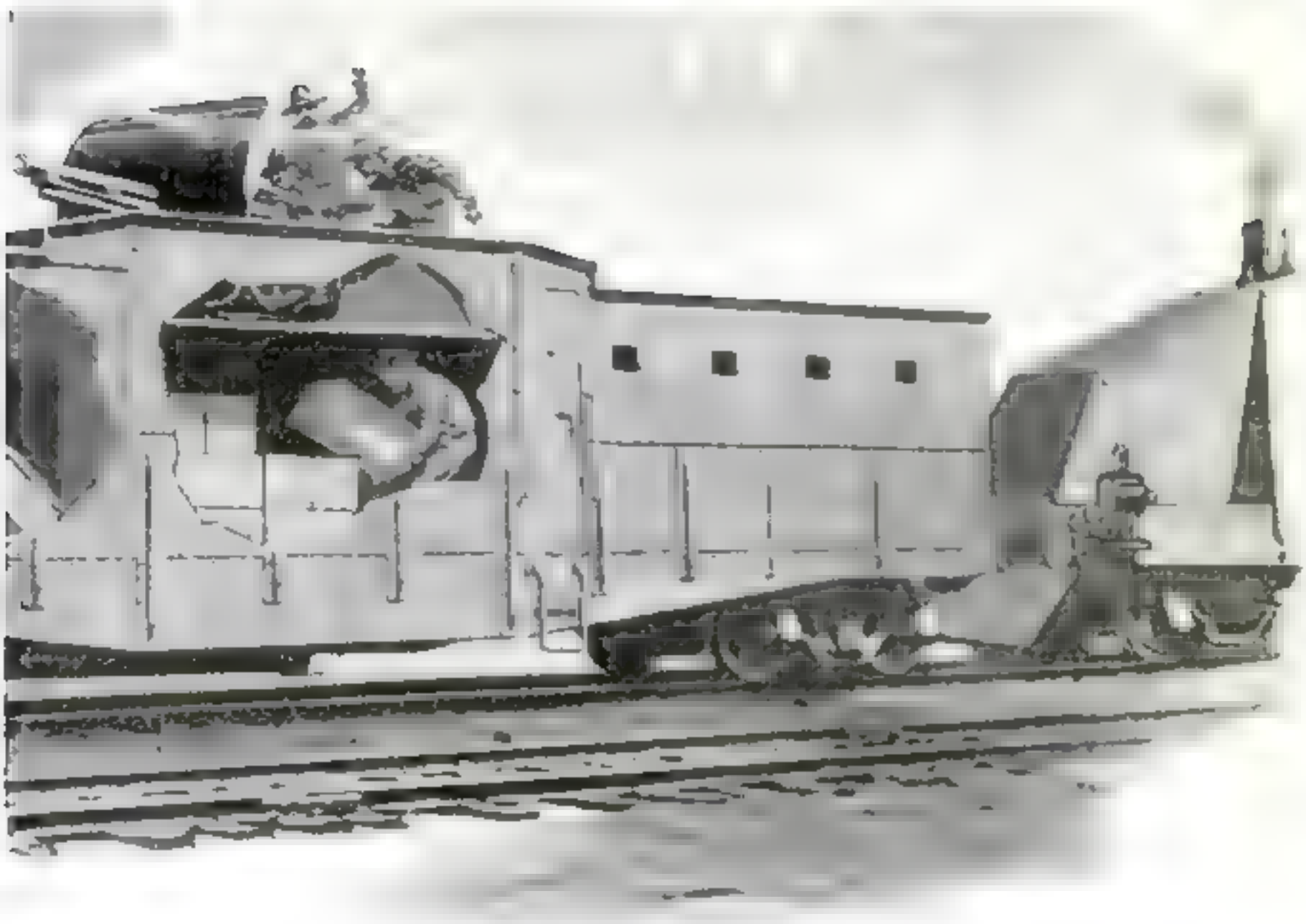
Our First Armored Car

THE first armored car to be constructed under the direction of the Board of Engineers of the United States Army has been inspected at the Sandy Hook proving grounds. The car was designed and built within twenty-seven days. It will no doubt be sent to the Mexican border, to be used in actual operation.

The service for which the car is intended is primarily to guard railroads and depots adjacent to railroads. It is not ordinarily to be employed in aggressive movements. In effect, it is a movable blockhouse which may be used at any point along the line. It may serve as a retreat for troops past danger points, or for the transportation of explosives or material of a perishable nature which might be damaged by fire from the ends.

The car consists of a heavy steel-plate structure erected upon a standard flat-car frame. The plate is of sufficient thickness to withstand fire from small arms. The interior is divided into three compartments. Through port-holes in the end compartments, machine-guns and rifles may be fired by soldiers within the car. The center compartment, which is lower than the full height of the car, is used for the storage of ammunition. Enough ammunition may be stored to supply the small arms and the three-inch rapid-fire field gun mounted on top of the car. This gun has a special recoil mounting. It takes a crew of three trained men to operate it. The gun-well may also be used as a fighting-top for troops armed with machine-guns or rifles

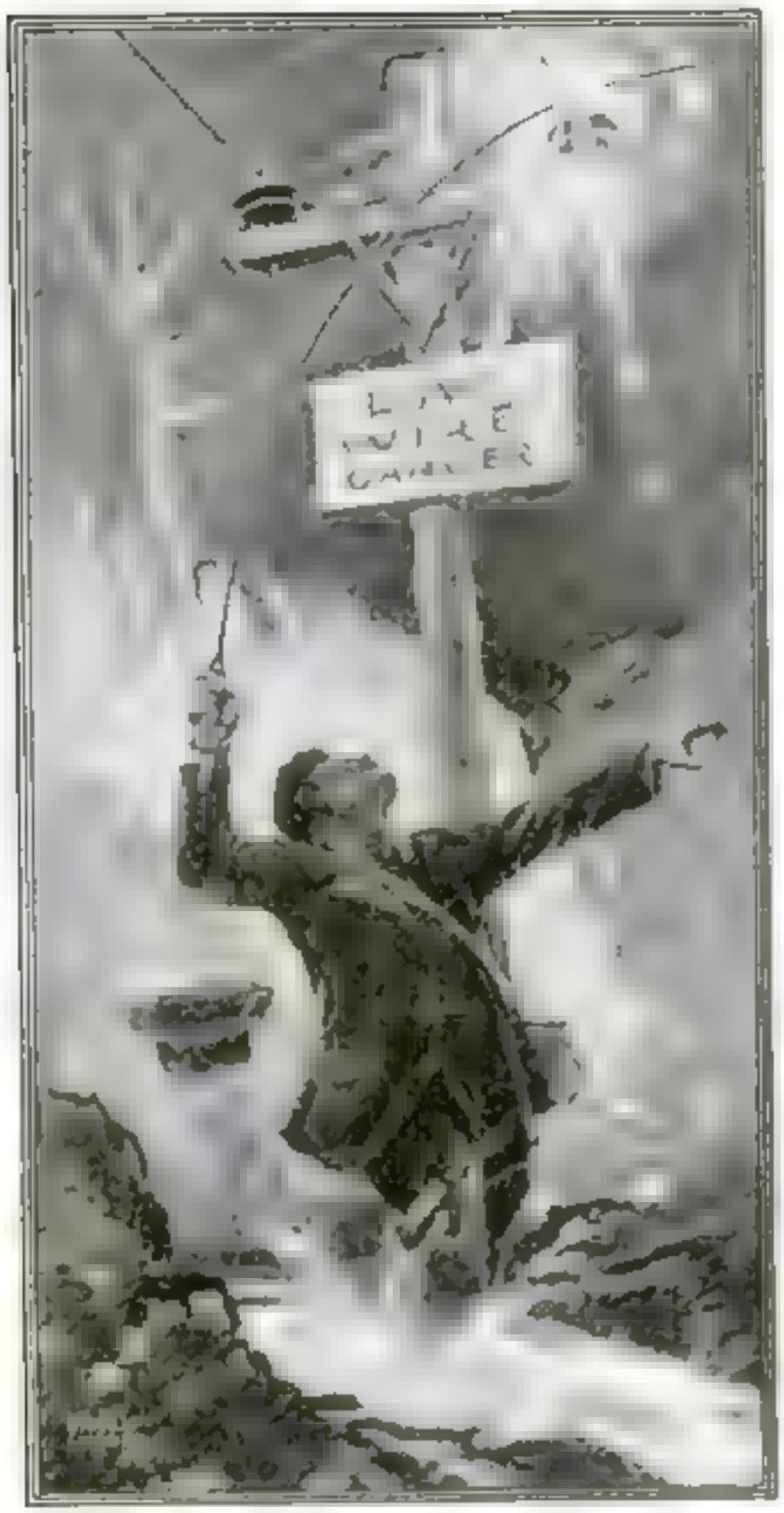
The car will accommodate a platoon of infantry seated on camp stools or on benches. When used for patrol purposes there would not be more than twelve men in the car, to operate the rapid-fire



gun and machine-guns. A dry-hopper lavatory and a water tank having a capacity of three hundred gallons, from which the water is brought to the interior of the car by a hand-pump, has been installed for the convenience of the soldiers. The car weighs approximately ninety-seven thousand pounds, which is less than the weight of the armored railroad cars now in use abroad.

There are twenty port-holes for machine-guns or small arms, eight being located on each side of the car and two in each end. These openings are covered with sliding doors of heavy steel when they are not in use. In addition there are also six peep-holes, two in each side of the car, and one in each end. Access to the car is obtained through four door openings, one on each side and one on each end. A ladder in the middle compartment enables the gunners to reach the gun-well at the top of the car.

The armored railroad car first came into use in South Africa. There it met with conspicuous success, opening the eyes of European nations to its serviceability in war. During the recent periods of internal strife in Mexico Villa's troops converted a freight car into a movable fort on wheels. It took part in a number of pitched battles and did excellent service in guarding the railroad's right-of-way and in transporting ammunition stores. Port-holes were cut in the sides and ends of the car and through these rifles and machine-guns were fired. The active part played by this car in a desultory war convinced our army officials of its military value. On the other hand, armored railroad cars were long ago introduced in Europe as the direct result of the splendid showing made by the first car in South Africa.



In making a long cast the steel fishing rod was thrown against high-tension wires and the fisherman was killed almost on the instant

A Warning to Fishermen

WHILE fishing in a small Pennsylvania stream the Rev. W. P. Perry was killed almost instantly when the steel rod he was holding became entangled in high-tension transmission wires over his head. He was wading in the stream at the time and whipping the water in the usual way. With no thought of the live wires he made a cast with the line and there was a blinding flash. The current of twenty thousand volts leaped down the rod, coursed through his body, and killed him before he could make an outcry.

This is said to be the first instance on record of the death of a man under such circumstances. During severe winter storms it is not infrequent to hear of electrocutions, due to fallen live wires hidden in débris.

Expending Four Tons of Energy in Playing the 'Cello

A SIMPLE air played on the violoncello calls for a total expenditure of energy equal to two and three quarter pounds per note or more than four tons of energy for the single selection. This statement is vouched for by Professor Poffenberger, of Columbia University, who made some experiments in his laboratory with the aid of the famous Dutch 'cellist Michael Penha—experiments made to determine the amount of sheer physical strength required to play the violoncello in the style of a great artist.

A special apparatus is necessary to conduct the tests. Against the surface of a revolving carbon cylinder is suspended a chalked point which is actuated by a slender wire attached to the musician's finger. At each pressure the tension vibrates along the communicating connection and records the energy expended.

When Michael Penha played a simple Bach aria this instrument registered an expenditure of more than four tons of energy

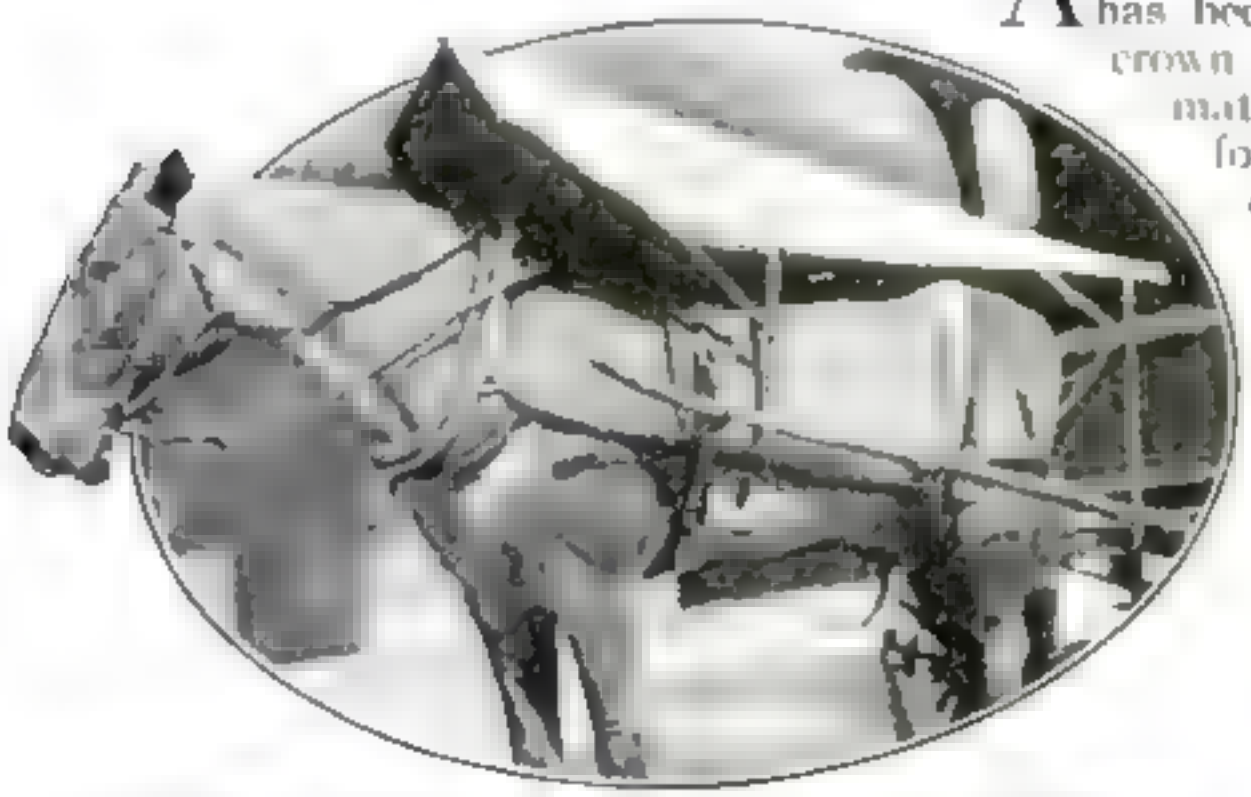
At a recent test Michael Penha at times raised the point to a distance equaling three pounds in weight, that being the record of the forefinger. The pressure alone required to produce the characteristically luscious tones of a simple Bach aria averaged two and three quarters pounds per note. The total energy expended amounted to nine thousand four hundred and fourteen pounds, or more than four tons

This same amount of energy would be sufficient to carry a laborer through his entire day's work. Yet it took but five minutes for the artist to exert the same amount of force.

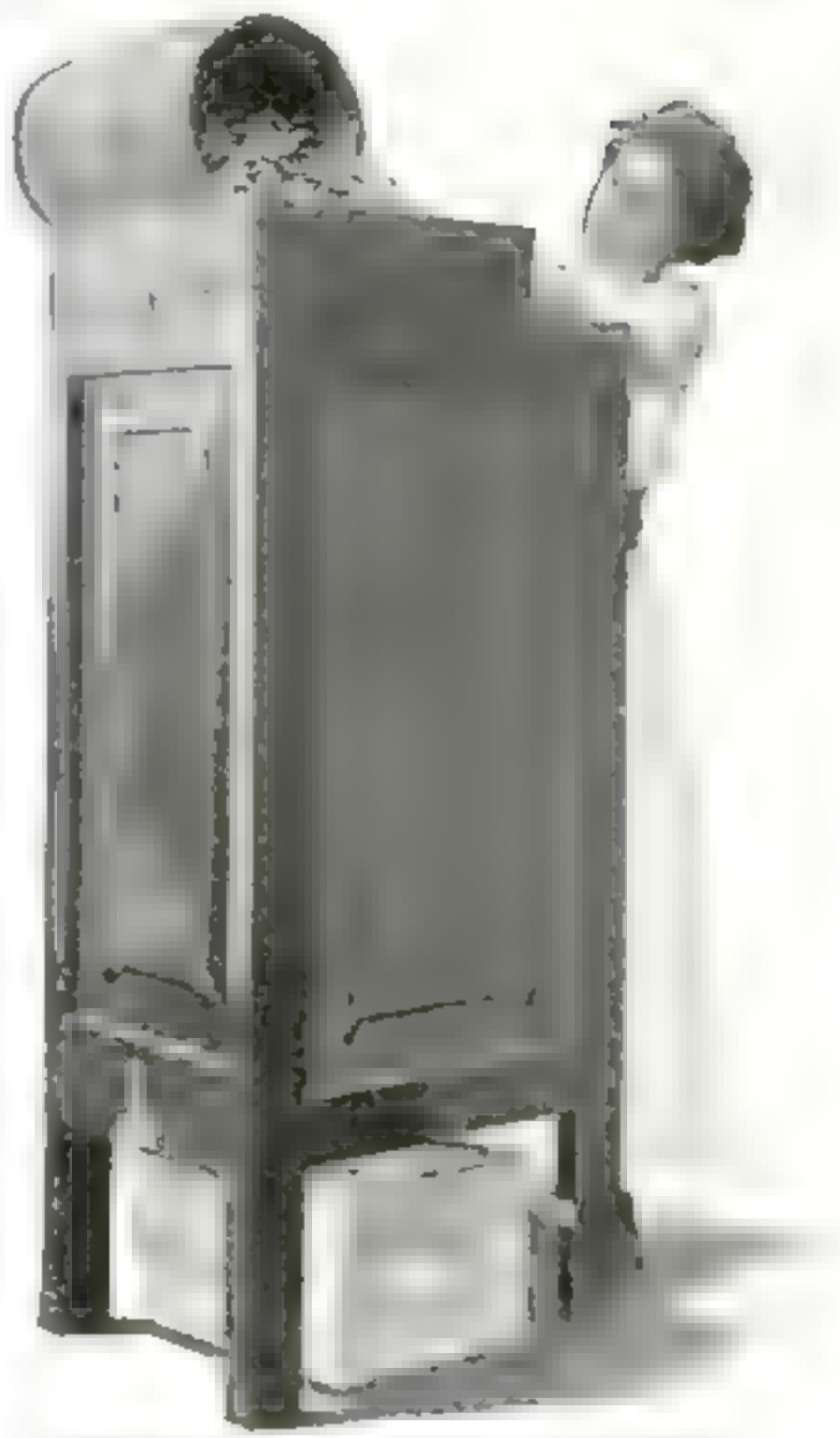
Old Dobbin Carries His Umbrella With Him

A CINCINNATI teamster who wants to make life more endurable for his horse during the torrid summer days when it is out in the broiling sun earning a living for him, has devised a horse umbrella which consists of a canopy of canvas stretched over a steel frame which clamps to the shafts of the wagon. The horse is thus effectively protected from the rays of the sun and wherever he goes he carries the umbrella.

When hitching or unhitching the animal it is not necessary to detach the canopy. The horse backs right under it between the shafts as if it were not there The umbrella not only serves its purpose as a protection against the sun, but it shelters the animal from rain.



A canopy of canvas is stretched over a steel frame which is clamped to shafts of the wagon but does not touch the horse

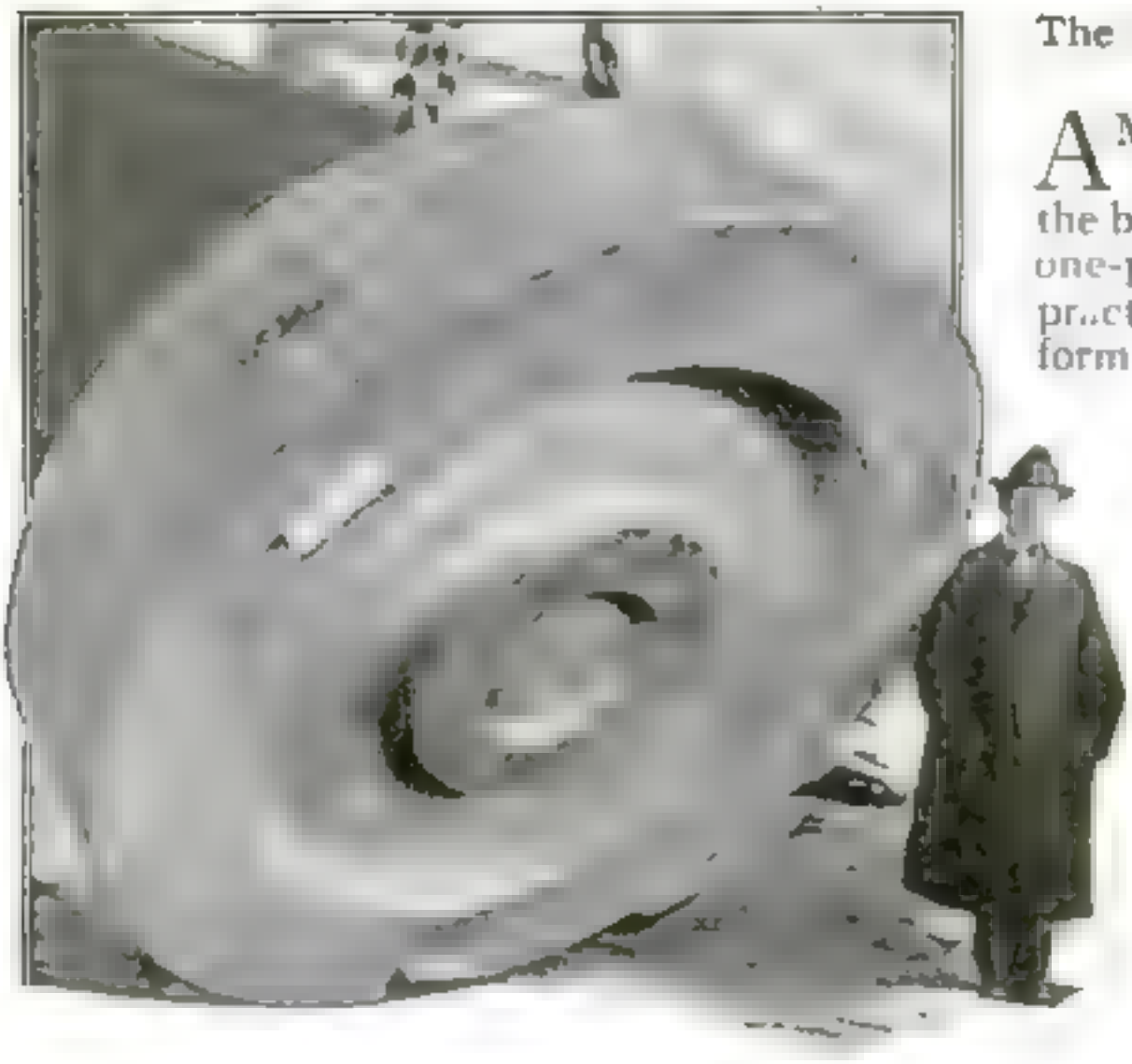


The dust collects in a drawer in the bottom of the hopper and the corks emerge cleaned

Cleaning Crown Bottle-Corks in a Portable Hopper

A PORTABLE automatic screener has been invented for cleaning crown bottle-corks and any material of granular or lump form, such as coffee-grain or the like. The illustration shows crown corks being dumped into the device. The corks emerge at the bottom, cleaned of any particles of cork or splinters.

The hopper has a series of zig-zag sloping screens in the interior. The corks roll from these zig-zag screens to a rotating wheel with radial screen vanes, which agitates them.



When this fifty-six-thousand-pound flywheel is spinning in the hold of a ship seasickness is prevented

Preventing Ships from Rolling by the Use of Giant Flywheels

TO travel over the roughest seas or through the most varying winds with no rolling or rocking of the craft is believed to be a coming possibility—if it has not already been achieved. The new principle has been applied to some of the smallest yachts and to aeroplanes and is now being extended to larger vessels.

The accompanying illustration shows the largest steel casting ever made for this new purpose. It weighs 56,000 pounds and is 10 feet in diameter and 27 inches thick on its face. Two of these are now being installed on a United States army transport. They constitute the principal part of what is termed a gyroscopic stabilizer.

The mechanism depends for its success on the fact that when revolving at a high rate of speed, the usual motion imparted to a vessel by the waves is offset by this revolving mass. This particular casting revolves 1150 times per minute

The Sidewalk Coaster Becomes an Automobile

A MECHANICAL cross-breed between the motorcycle and the boy's sidewalk coaster, is the one-passenger motor vehicle practically a motor-driven platform, illustrated below. Its pressed steel platform suspended four inches from the ground between wheels is fitted with pneumatic tires. The motor is attached to the front wheel and provides ample power to meet all road conditions.

The fact that you stand in driving the vehicle and the further fact that your weight is carried between the wheel centers, makes it very easy to balance the machine. There is practically nothing to watch but the handlebar which supports the rider and steers and controls the operation and speed of the machine. Both brake and clutch are operated by moving the handlebar forward or backward.

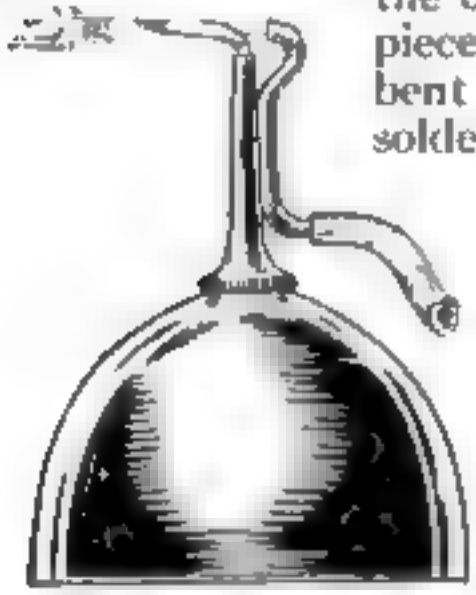
The machine is intended primarily for short distances but enough gasoline can be carried in the tank for a trip of one hundred miles. The speed can be increased to twenty-five miles an hour.

The handlebar controls the speed of the machine, steers it and operates the brake and the clutch

For Practical Workers

How to Make an Alcohol Lamp and Blow-Torch from an Oil-Can

THE spout of the can is cut off so that about 2½ in. remain above the thread. This portion of the tube is then filled with a wick the same as for the ordinary torch. A piece of brass tubing, bent as shown and soldered to one side of the spout, provides a means of attaching a small rubber tube for a blow-pipe. Wood or denatured alcohol is used for the fuel. A torch made up in this manner can be used for soldering in very difficult places as the flame may be easily directed into places that cannot be reached with a soldering iron or with the flame from the ordinary kind of alcohol lamp.—LAWRENCE V. GREENHAUS.



The piece of brass tubing carries a rubber blow-pipe

Two Good Calking Compounds for Boats

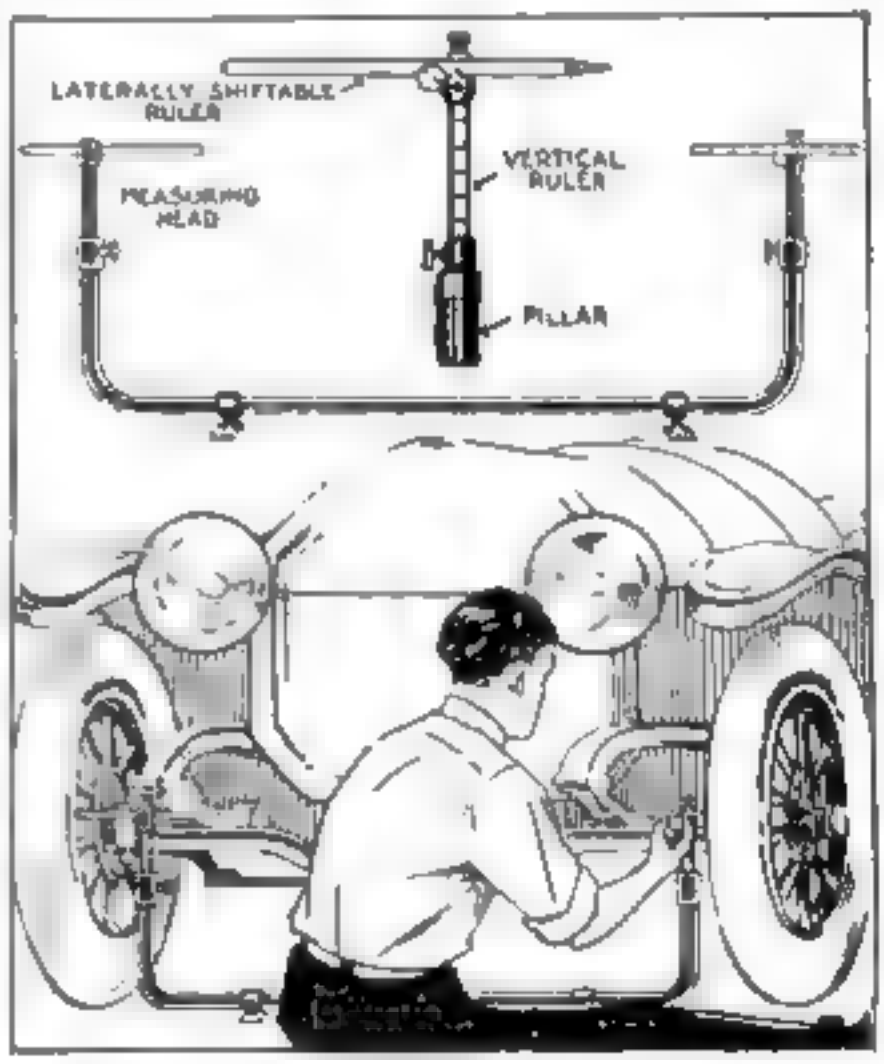
THE best calking compound used is made of equal parts, by measure, of white lead ground in linseed oil and paraffin. Put the white lead in an iron pot and heat it, then stir in the paraffin. While still hot apply to the seams with a seam brush. This mixture will make any boat water-tight and will not contract and fall out of the seams as some compounds do.

Another good compound is one part Portland cement to six parts coal-tar. Boil and brush over the entire boat bottom while hot. This mixture is generally used as an extra heavy calking for old boats.—J. J. STURMER.

Making Automobile Wheels Track Correctly

MOTORISTS are often puzzled because one tire will wear out faster than the others and give considerably less than the required mileage. Generally the trouble is always experienced with the same wheel and the tread appears to have been ground away by a coarse emery wheel. If this condition exists, it is time to check the alinement of the wheels to make sure they track correctly. The recently invented device illustrated makes it possible to do this in an accurate manner.

It consists of a base-piece of pipe resting on cast-iron feet or pads and having sliding heads in the pillars at



The base-piece rests on cast-iron pillars with sliding heads which are graduated rulers

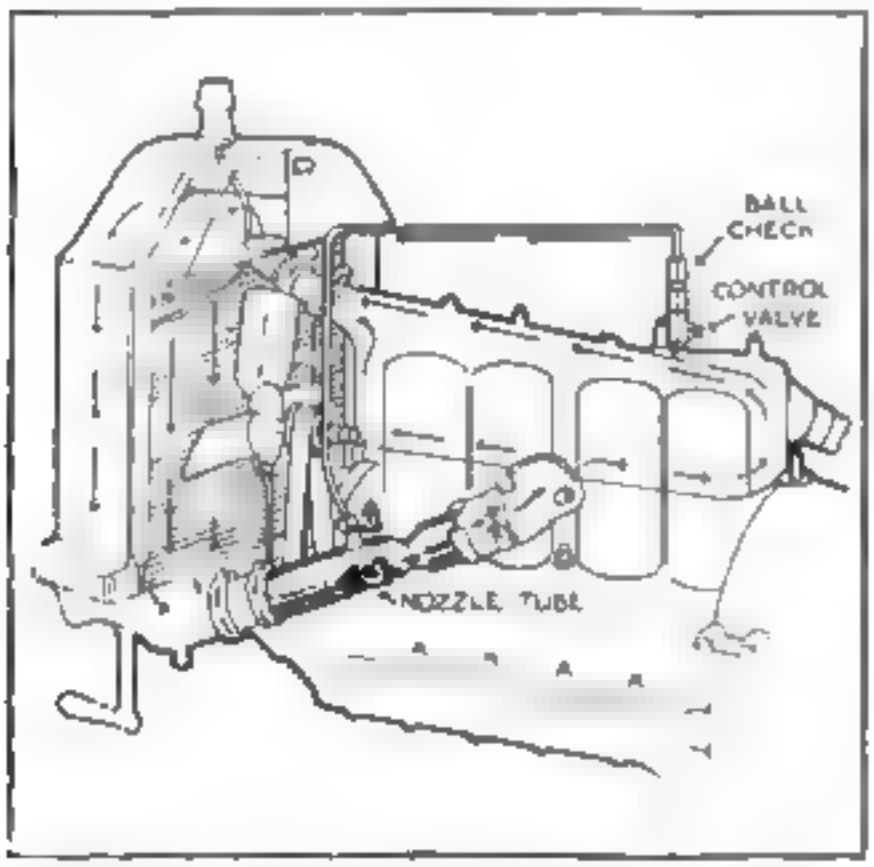
each end. These are graduated, one of the rulers having a vertical movement whereas the horizontal one can be moved laterally and both can be set when the measurements have been as-

certained. The front wheels are the worst offenders and if the wheels "toe-in" or out unduly, rapid tire depreciation is unavoidable because the wheels do not roll freely and the tires have a combined rolling and sliding action which is very destructive to the treads. The method of using this fixture is also clearly outlined.

Accelerating the Cooling Water Circulation

THE engines of many popular light automobiles are cooled by the natural or thermo-syphon system of water circulation, which depends upon the displacement of hot water in the water-jacket by heavier, cooler water from the radiator. This method of circulation gives good results, but some favor the more positive and faster movement of the cooling liquid such as is produced by the use of a pump.

Unfortunately, it is not always possible to instal a pump in a system designed for natural circulation. The flow of water may be accelerated by the simple device shown in the illustration. One of the water-pipes is fitted with a

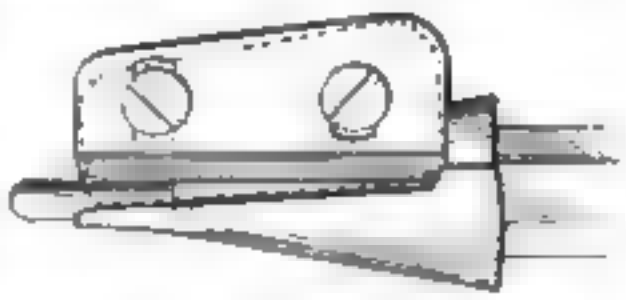


An arrangement for quickening the cool water circulation by an injector action

tube so that the enclosed end points up and on the outside carries a nozzle connected to the exhaust manifold by a tube attached to a ball-check fitting. At every explosion an easily variable quantity of gas is by-passed to the nozzle and circulation is quickened by an injector action. The check-valve is necessary to prevent water being drawn back into the engine should it backfire. Arrows show the direction of gas and water.—V. W. Page.

A Pencil Sharpener with an Adjustable Blade

MANY persons find it a serious objection to pencil sharpeners that it is impossible to get a sufficient length of point on a pencil, the sharpeners ordinarily cutting the lead at the same taper as the wood, bringing it to a point only a short distance beyond.



By loosening the outer set-screw the blade is adjusted

A pencil point of any length may be obtained by the use of one of the familiar forms of sharpeners such as illustrated, in which the blade is adjustable by means of set-screws at each end, the cutting edge of the blade extending across the axis of the pencil.

By loosening the outermost set-screw and moving that end of the blade outwardly to a slight extent, as indicated by the dotted line, the lead is allowed to pass the blade without being cut, and the thickness of the point portion may be determined by the distance the blade is swung.—Christian Nielson, Jr.

A Quick Method of Repairing a Broken or Cracked Die

PART of a broken tooth on a male gear-die which was wanted in a hurry had to be renewed. The broken tooth was dovetailed (after annealing) and a piece of cast steel fitted in and roughly finished. It was then carefully brazed and annealed while cooling. After cooling, the brazed tooth was finished with a file and the whole die tempered as usual, care being taken not to heat enough to melt the brazing.

The job stood well, thousands of brass gears 1/16 in. thick having been punched with the repaired die.

Equipment for the Home Worker

J. H. Constantine

Instructor in Industrial Arts, Teachers' College, Columbia University

ANY man with a few well selected tools and an ordinary amount of skill can eliminate the expense and trouble of calling in a mechanic every time there is some little house repairing to be done. In selecting an equipment it is not a good plan to buy one of the sets made up in cabinets, as there are generally tools in these that are unnecessary and in some instances of an inferior quality. A better plan to follow is to consider the character of the work likely to be done, then select the necessary equipment to do it, purchasing only high-grade tools, as these will do the best work, last longest, and therefore are cheapest in the end. Any dealer who makes a specialty of supplying tools for schools or amateurs can give valuable advice on this subject. The following tools generally meet all the requirements of the beginner and additional ones can be obtained as the need for them arises.

The Bench

A strong bench is a necessity if accurate work is to be done, the essential features of which are:

I. Rigidity: This may be secured in a bench made with mortise and tenon joints, or of draw-bolt construction, Fig. 1. The bench should be firmly fastened to the floor by lag-screws passing through the two foot-pieces.

II. An ash or maple top with a trough at the back.

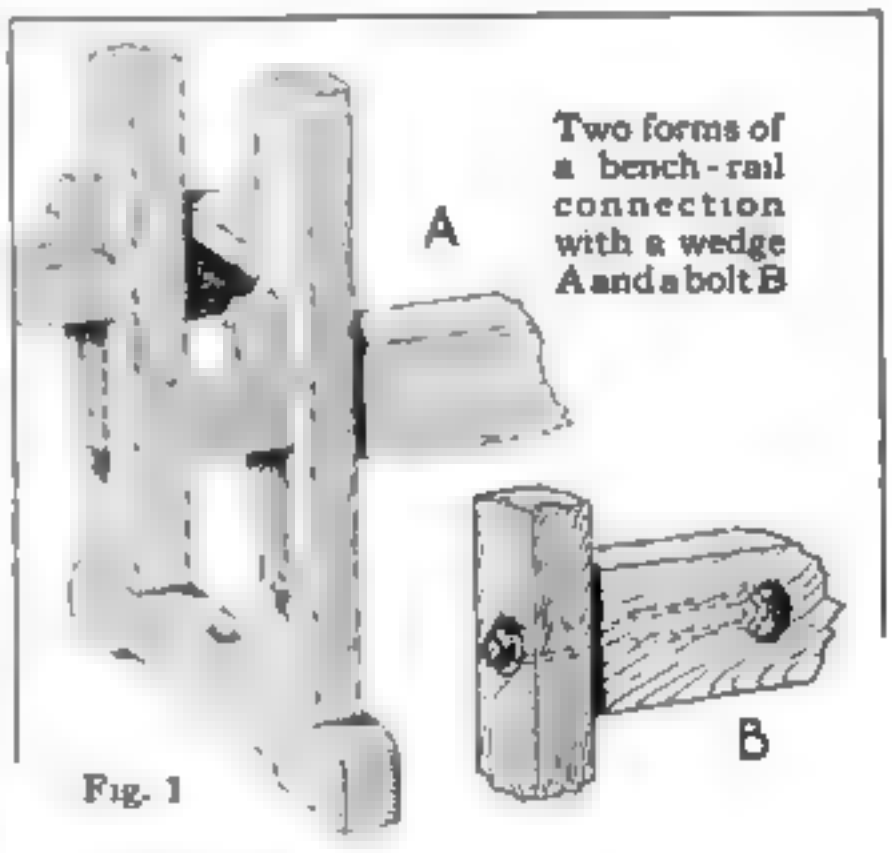
III. A drawer or rack where the tools can be kept when not in use. The former is more satisfactory.

IV. A side vise: The strongest, most durable and convenient is the rapid acting vise, with all working parts of metal. This vise requires oiling occasionally. Facing the jaws with maple prevents injuring finished work.

V. A tail vise: This vise, also of metal with a long screw not rapid acting, is very convenient for certain kinds of work.

The bench may be made at home, or bought for from $9 50 to $24, depending on the style and size.

The following list of tools may seem large to the average man, but the writer has found from experience that occasions are sure to arise when each tool will be needed in general house repairs.



Two forms of a bench-rail connection with a wedge A and a bolt B

Fig. 1

1 Stanley jack plane No. 605.
1 Stanley block plane No. 65½
1 Iron spokeshave No. 54.
1 Disston cross-cut saw 22 ins. 10 points.
1 Disston rip-saw 22 ins. 8 points.
1 Disston back-saw 10 ins. No. 4.
1 Buck Bros. socket chisel 1½ in. handled and sharpened
1 Buck Bros. socket chisel ¾ in. handled and sharpened.
1 Buck Bros. firmer chisel ¾ in. handled and sharpened.

1 Buck Bros. firmer chisel ½ in. handled and sharpened.
1 Hammond adz-eye claw hammer, 9 oz.
1 Disston hardened blade try-square 6 ins.
1 beech marking gage
1 Buck Bros. outside bevel gouge 1 in handled and sharpened.
1 Buck Bros. inside bevel gouge ½ in. handled and sharpened
1 box-wood rule, No. 2, 4 fold .
1 Disston sliding T-bevel No. 3, 6 ins.
1 pair Starrett spring dividers 8 ins.
1 bit file.
1 slim taper saw file 6 ins
1 rat-tailed wood file 8 ins. handled.
1 key-hole saw.
1 Barbers ratchet brace No. 33, 8 ins. sweep.
1 mitre-box.
2 Jorgenson hand-screws 10 ins.
1 monkey-wrench 6 ins.
1 screw-driver 8 ins.
1 screw-driver 4 ins.
1 pair pipe-pliers.
1 pair side-cutting pliers.
1 hack-saw frame.
6 hack-saw blades.
1 Stilson wrench 10 ins.
1 glass cutter
1 nail-pull (nippers).
1 Carborundum oil-stone, medium and coarse combined, in iron box.
1 set Russel Jennings auger-bits 4 16 in. 5/16 in., 6 16 in., 7 16 in., 8 16 in.
1 nail-set 1/16 in.
1 set twist-bits 3 32 in., 4 32 in., 5 32 in., 6/32 in., 7/32 in.
1 Clarke's expansive bit ½ in. to 1½ ins.
1 Taintor saw-set.

The cost of the equipment listed, without the bench, will be about $24.

Supplementary list of tools useful but not indispensable

1 Langdon iron mitre-box with back-saw
1 Parker iron vise
1 pair Compton's metal snips No. 12, 2 ins.
1 foot-power grind-stone or No. 10 Carborundum tool grinder.
1 saw-filing vise.

The cost of this supplementary equipment is about $20.

Care of Tools

One of the most common faults of the beginner is to work with tools after they are dull. All edged tools should be sharpened often and carefully, in order to keep them in perfect condition.

Chisels and Plane-Irons

These tools come ground to 20 or 23 degrees as indicated in Fig. 2. They should be whetted on the medium side of the oil-stone to an angle of 25 degrees Use plenty of kerosene oil to prevent burning the tool or glazing the cutting surface of the stone. Rub over the entire surface so the stone will wear evenly. The whetting will raise a thin wire edge on the tool which can be partially removed by turning the chisel or plane-iron over on the flat side and rubbing it gently back and forth on the stone. It is very essential, however, that the tool be kept perfectly flat during this operation, as any bevel on the flat side impairs its efficiency. If any roughness remains on the cutting edge it may be removed by stropping on a piece of

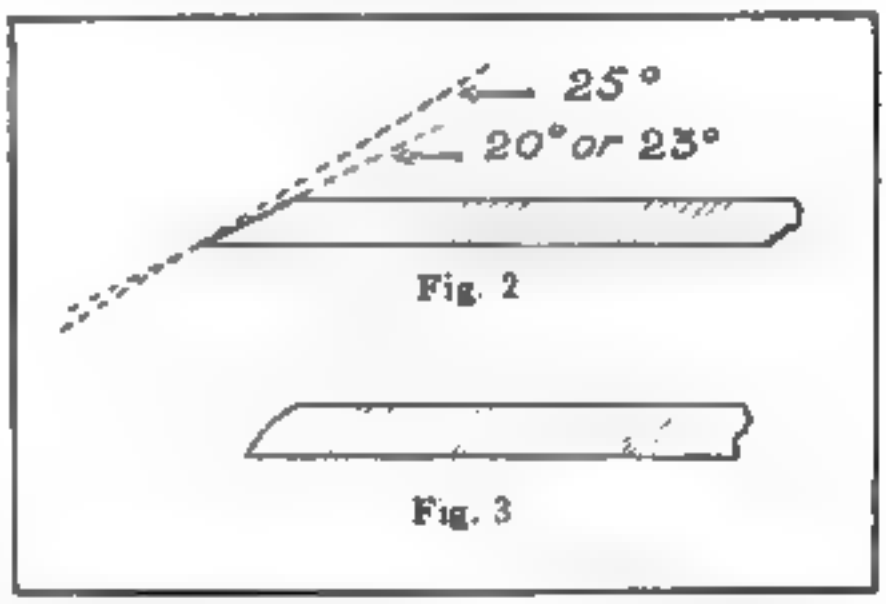


Fig. 2

Fig. 3

The bevel of a chisel as it is when new and after it has been used for some time

leather. After these tools have been whetted often the bevels will assume the shape shown in Fig. 3. In this case they must be ground to restore the original angle of 20 degrees. The grinding may be done on a grind-stone or emery-wheel. If neither of these is available the coarse side of the oil-stone will answer the purpose. The cutter for the spoke-shave may be sharpened in the same way. The gouges must be sharpened on a slip-stone, that is, an oil-stone, shaped to fit the curve of the tool.

Saws

Saws are divided into two classes: those for ripping and those used for cutting across the grain of the wood. In the rip-saw the teeth act like chisels and chop off the end grain, while the cross-cut tooth is shaped like a knife,

and has the same shearing action. The shape of the two types of teeth is shown in Figs. 4 and 5. The best modern

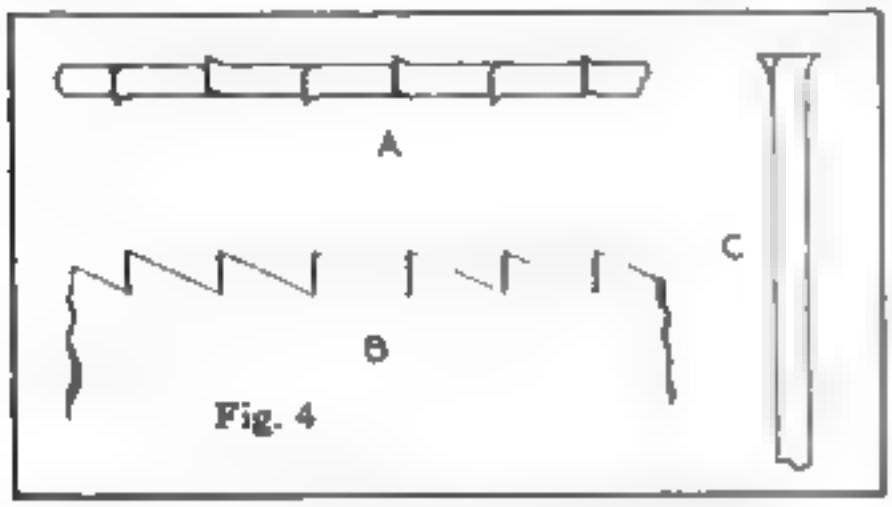


Fig. 4

The teeth of a rip-saw act like small chisels to chop off the end grain of the wood

saws are made thinner at the joint than at the heel (handle end) and the blade tapers from the cutting edge to the back. This stiffens the saw where stiffness is needed, and saws made in this way need very little "set."

The rip-saw is designed to work with the greatest efficiency when cutting with the grain of the wood. The shape of its teeth is the result of experience in combining such features as the strength of the tooth, the acuteness of the cutting angle, and the ease with which it may be sharpened. The steel in this saw is softer than that in many other wood-working tools, in order that it may be more easily filed and set. This necessitates frequent sharpening, particularly when the tool is used on hard woods. In general the rip-saw tooth has an included angle of 60 degrees, with the face at an angle of 90 degrees to the line of the teeth and to the blade. (Fig. 4.) This saw will not work successfully

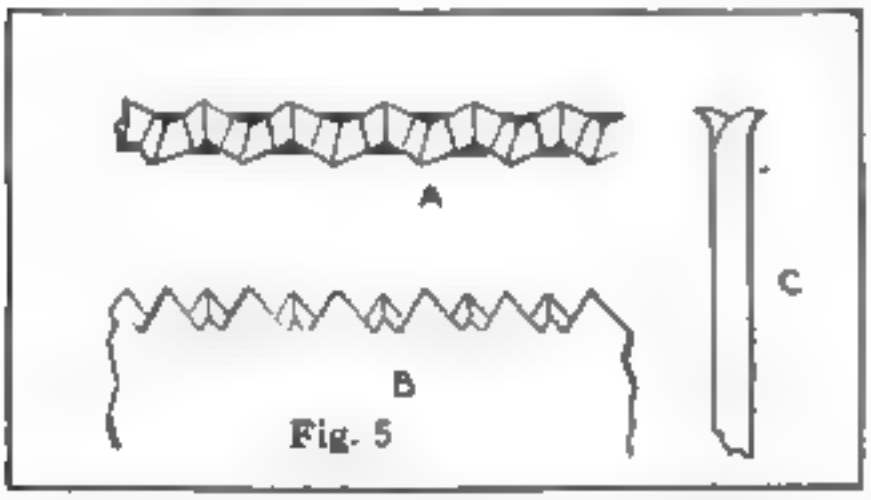


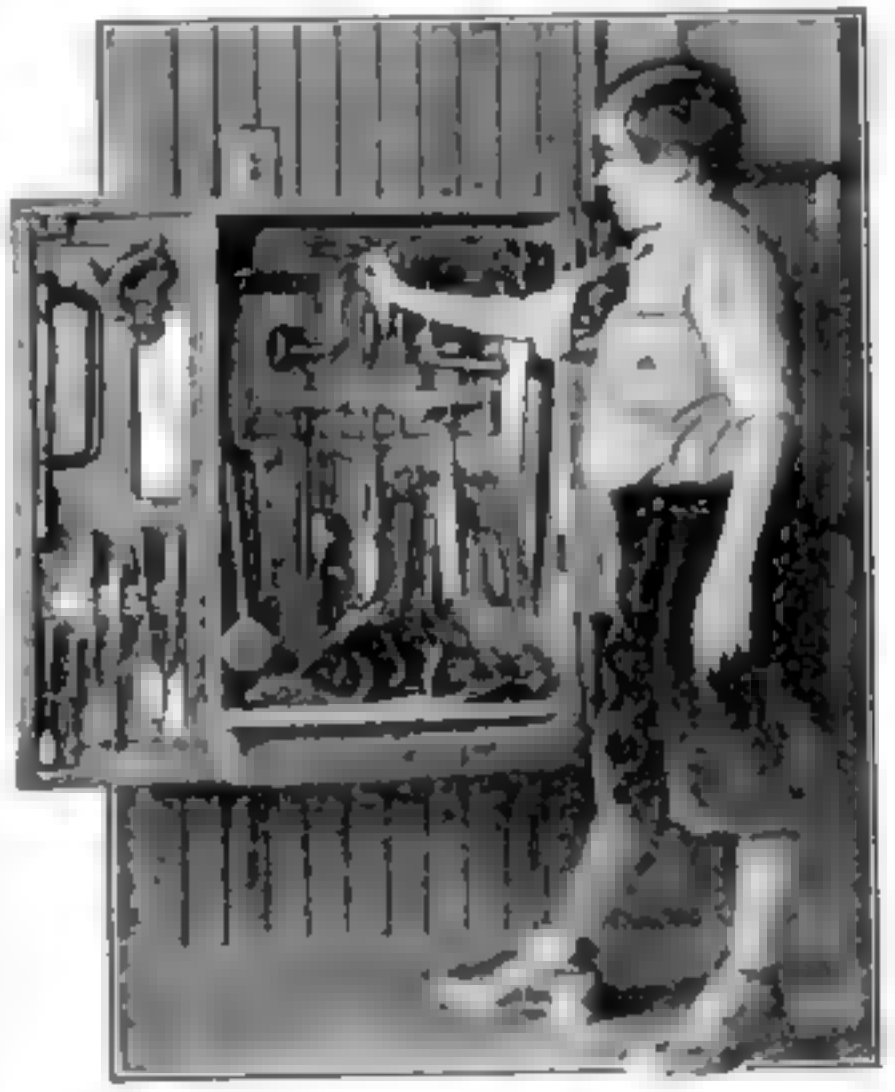
Fig. 5

The cross-cut saw with its keen knife-shaped teeth cuts slowly across the grain

across the grain, as the teeth, having no shearing angle, tear the wood-fibers instead of cutting them, and leave a rough and jagged surface. It may be used, however, in making a diagonal cut, where it works much faster and nearly as smoothly as the cross-cut.

The cross-cut saw with its knife-shaped teeth, cuts slowly across the grain, leaving a smooth surface which for many purposes does not require any further finishing

In all fine cabinet work an allowance should be made for chiseling or planing the cut surface, to remove saw marks. When ripping a board, keep the saw cut about 1/16 in. away from the line, and plane the edge true. To start a cut with the rip-saw hold the saw firmly and



The arrangement of the tools in the cabinet back of the inner swing-door

move the teeth lightly over the edge of the board. Use the thumb of the left hand as a guide. If the saw is kept nearly parallel with the board it is not absolutely necessary to start with a back stroke.

A light, slow stroke is much more effective than a hard, quick one, which tends to buckle the saw and cause it to jam in the board. Sometimes, due to shrinkage, the board has a tendency to bind the saw in the "kerf," or cut. To remedy this, insert a screw-driver in the "kerf" and rub a little heavy oil or grease on the blade of the saw.

Filing and setting a saw correctly requires considerable practise; it is therefore a good idea to obtain an old or cheap saw on which to practise before attempting to sharpen the good one. A saw for this purpose can be purchased for ten

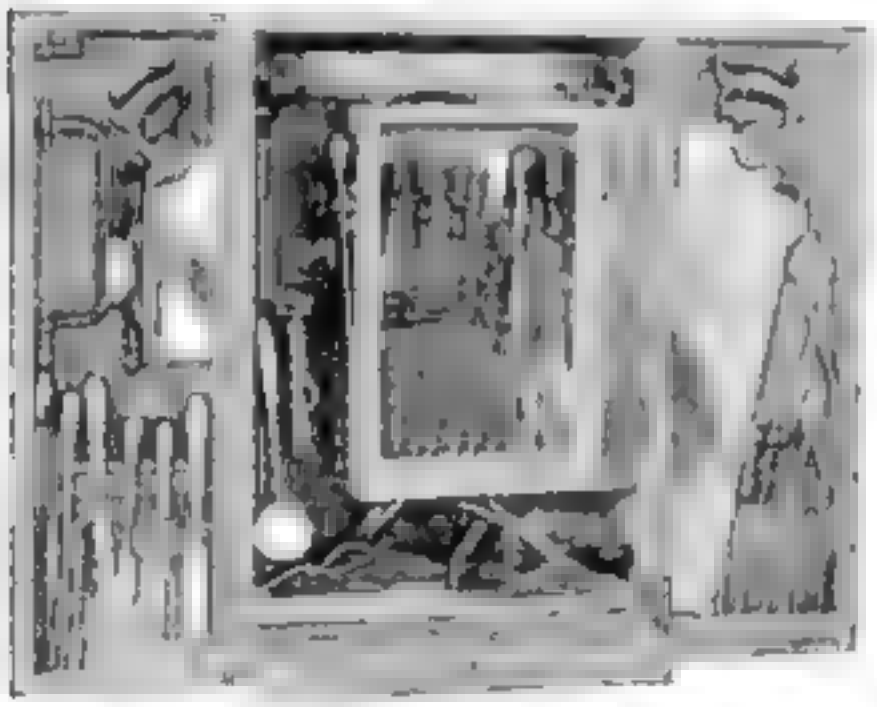


Fig. 6. A well arranged cabinet to hold all the necessary tools for hand wood-working

or fifteen cents in any store that handles cheap tools. The saw to be filed and set is first placed in the saw-vise, which may be two pieces of hardwood held in the vise, or a vise made especially for the purpose. The teeth should project about ¾ in. above the top of the vise. "Joint" the saw by running a flat file over the points of the teeth from end to end, bringing all the teeth to the same level. Then "set" or bend every alternate tooth to one side, turn the saw and repeat this operation, following the original set of the saw. When this is done the saw is ready to be filed. Use a triangular file for both the cross-cut and the rip-saw. In filing the cross-cut saw, the file should be held at an angle toward the point of the saw sufficient to give the tooth a knife-like cutting edge. First file the alternate teeth, set away from the worker, filing with the set. When each tooth has been brought to a point, reverse the saw and file the remainder in the same manner.

The rip-saw is jointed in the same way as the cross-cut, but all the filing is done on the back of the teeth, and the file held at right angles to the line of the teeth and the blade. File with the set. When this operation is finished, rub the sides of the teeth lightly with the oil-stone to remove wire edges.

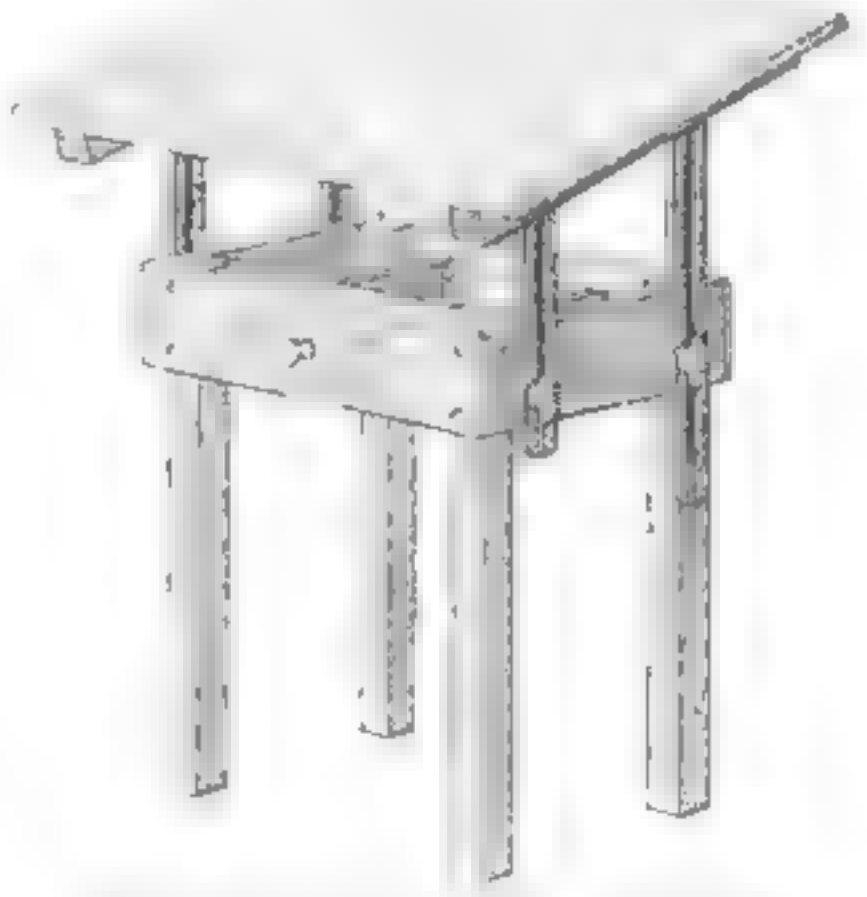
Auger-bits may be sharpened by filing the nibs and cutting lips with a bit-file. This must be done carefully in order that the bit may cut evenly.

Rub all tools with a piece of oily waste occasionally, to prevent them from rusting.

A cabinet in which to keep the tools can be easily made. A very well arranged one is shown in Fig. 6 The joints can be fastened with screws to simplify construction.

To Make a Combined Drawing Table and Stand

A DRAWING board which when not in use may be set to a lower position and used as a stand will be found useful in places where the need for such a board is too infrequent to warrant the expense of a drawing table. The size of the board will depend on the drawings to be made. For ordinary use, 24 in. by 36 in. will be sufficient. Cleats of wood are screwed to the lower surface of the board about 3 in. in from its ends. The screws should pass upward through



The drawing board, which is easily adjustable, forms a top for the table

the cleats and enter the board. Holes 1 in. deep are bored into the cleats to countersink the screw-heads. The cleats are made of stock 2 in. square.

The legs of the stand are about 28 in.

long and are also made of the 2-in. square stock. The common rabbet joint may be used for the front and side rails of the stand and the side rails are then nailed to the front and back rails with finishing nails. The rabbet joint may also be used for making the drawer.

The legs are screwed to the rails as shown. Four slotted bars are used for supporting the drawing board above the stand. Each bar is made of two strips 1 in. by ¾ in. The front bars are 16 in. and the back bars, 24 in. long. Select two strips which are to constitute one bar and place small blocks of wood 2 in. long between them at their ends and nail the strips together.

Screws pass through the bars about 1 in. from their upper ends and enter the cleats, thus supporting the drawing board.

When changing the adjustment of the drawing board, it is best to raise or lower one side, say the front or the back, at a time. Since the drawing board is supported at four points, it provides a more solid working surface than the usual type of boards supported at the center only.—C. H. PATTERSON.

A Spanish Windlass Made from Two Broomsticks

ROBINSON CRUSOE had a hard time of it moving his big canoe down to the water, but if he had known of the Spanish windlass his task would have been much easier. This windlass is used by lumbermen for pulling with ropes, the only apparatus needed being two stout sticks.

Two broom-sticks are strong enough to pull to the limit of the strength of a large rope. One end of the rope being tied to the boat, log, or other object to be moved, and the other end being made fast to something stationary, one of the sticks is held upright against the rope, with one end resting firmly on the ground.

The first stick should be held by the left hand on the near side of the rope. The other stick, held in the right hand, is next thrust down on the far side of the rope, and brought against the near side of the first stick. By pulling and bearing downward it is brought to the position shown in Fig. 1. By continuing to swing the second stick, it is an easy matter to wind the rope on the first stick, as shown in Fig. 2.

The first stick, which serves as the windlass, will move toward the stationary object half as fast as the movable

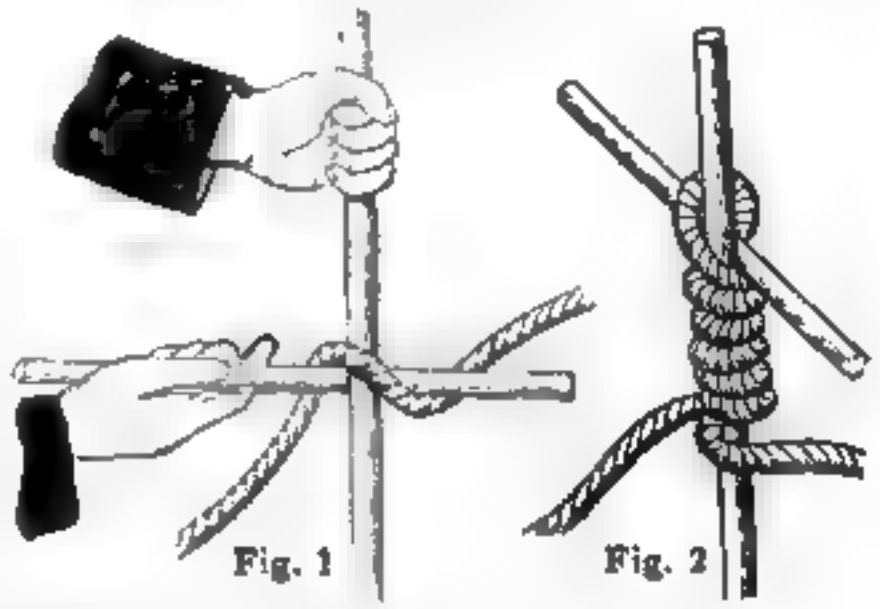


Fig. 1 Fig. 2

Manner of using two broomsticks as a windlass for hauling objects with a rope

object at the other end of the rope, and must be held approximately upright, so that the two parts of the rope will wind as closely together as may be. If these are not allowed to run apart, the tilting strain on the windlass will be comparatively slight.

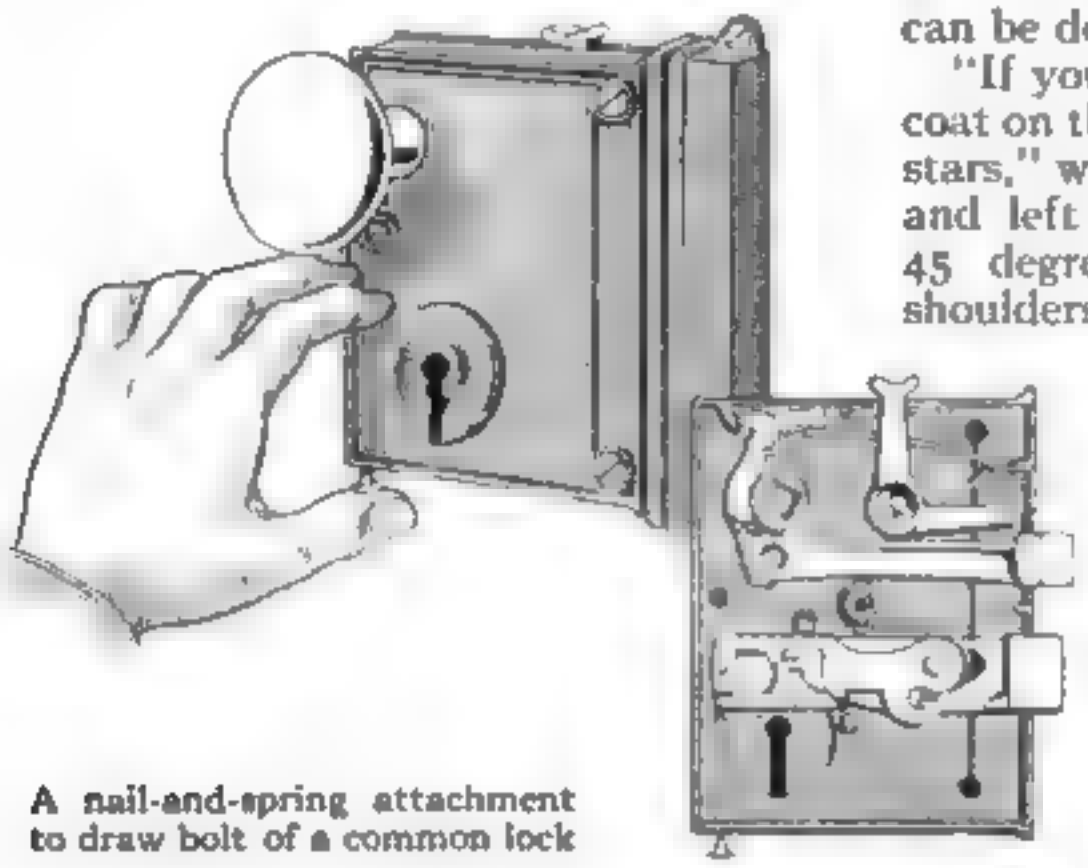
Of course two can work the device much more easily than one, but one alone can do very effective work with it. The object cannot be moved any great distance at one operation, but if you unwind the rope after the windlass is wound full and take up the slack and repeat the operation, the probable distance which it can be moved becomes unlimited.—E. R. THORTON.

How to Protect the Surface of an Enameled Road-Sign

THE use of enameled road-signs has become very popular, but although they are very attractive when in perfect condition they are anything but things of beauty when the enamel has begun to chip. There is a remedy for this evil, which will effectually protect the signs from serious injury from stones or other objects. Drill holes at the back of the sign, at the top and bottom. Attach supporting brackets for holding a thin wire mesh over the face. This will not interfere in the least with the reading of the sign.—C. H. THOMAS.

An Ingenious Attachment for a Door-Lock

AN attachment shown in the accompanying illustration of an ordinary door-lock, permits of opening the lock from the inside, without the use of a key. The lock is not changed from its original form, and can be operated with the key in the usual manner if desired.



A nail-and-spring attachment to draw bolt of a common lock

An ordinary wire nail and a small piece of clock-spring constitute the necessary parts. The spring is attached to the bottom of the lock in such a way that when it is released the bolt is withdrawn. The nail is inserted through the bottom edge also so that its upper end will lift the tumblers out of position and release the bolt.

Finding Your Bearings at Night Without a Compass

AN English survivor of the South African War who was often sent on long-distance night reconnoissance has worked out a system whereby anyone can be right at home in the dark without compass or other instrument to aid the sense of direction. He worked out the exact movement and direction of the largest and most easily distinguished lights in the heavens so that the least scientific eye can recognize these signs by sight and the whole dome of the heavens becomes a vast compass.

If there were fire balloons or beacons placed in the heavens north, east, south and west it would be easy for anyone to go in these directions by simply following the signs. Similarly, if one wished to go, say, a hand's breadth to the right or left of the beacons one could easily do so. The largest stars in the heavens can be depended upon in the same way

"If you put the front buttons of your coat on the North Star or other direction stars," writes this authority, "your right and left breasts give you an angle of 45 degrees from the star and your shoulders a right angle. Also, it is only a matter of a little practice to be able to measure 15 degrees of horizon with your hand, so you can get any number of degrees to the right or left of your direction stars, and after a little practice it becomes second nature to recognize the points of the compass at sight, and you acquire the same sense of direction as Bushmen, Arabs, and people who live far away from civilization

"The North Star, Altair and Vega are all-sufficient night-guides during the spring and summer, and for autumn and winter the North Star, the sword and belt of Orion, Procyon and Regulus."

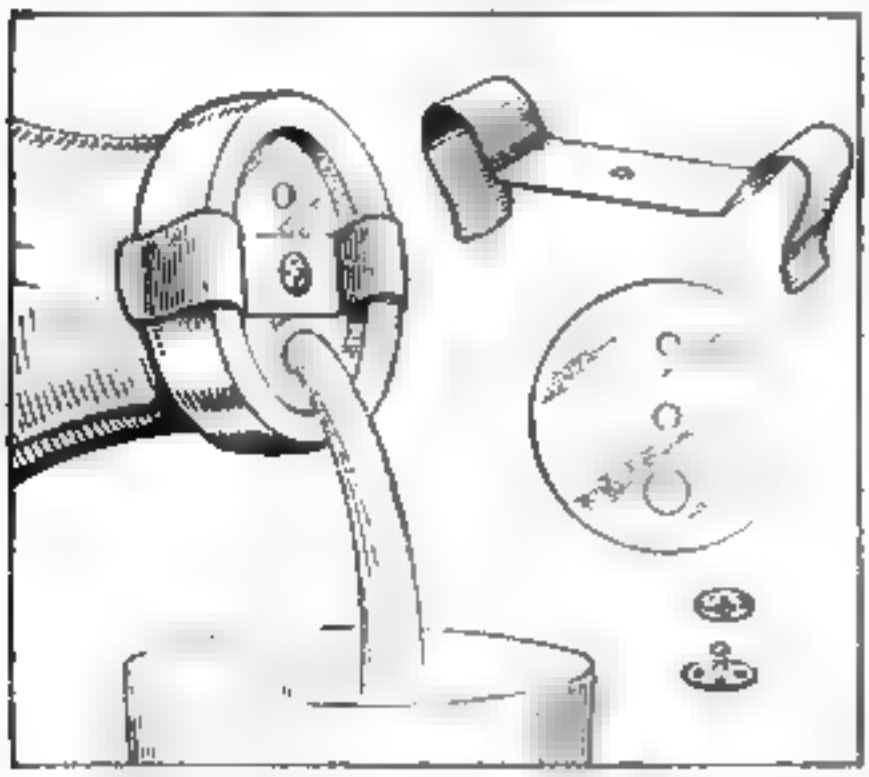
To Make a Sanitary Cap for the Milk Bottle

TAKE a piece of flat spring steel, such as a piece of corset stay or clock-spring, if not too heavy, ¾ in. wide, the length to be determined by the size of the milk-bottle neck over which it fits. Probably 4½ in. will be about the right length. Bend as shown in the illustration, making a spring clip to conform to the top of the bottle. Drill or punch a hole 3-32 in. in diameter in the center of the clip. Cut out a disk of transparent celluloid, such as is used in automobile curtains, of the right diameter to drop easily into the neck of the bottle but large enough so that it lodges on the ledge, in the neck of the bottle upon which the original paper cap rested.

With a punch or sharp-pointed knife, make three circular holes in this disk, one in the center 3-32 in. in diameter, another one ⅛ in. in diameter 7-16 in.

from the center, and the third 9-32 in. in diameter 7-16 in. from the center. Make these three holes in line.

Procure a snap fastener, such as is commonly used on women's clothing, and insert the ball end in the center hole of the celluloid disk. Place the spring clip on this and snap the top part of the fastener in place. If desired, a rivet and small metal washer may be used in place of the fastener, as this allows the cap to be taken apart. Be sure to have the ears of the clip high enough to allow the disk to rest on the ledge in the neck



The cap in position in the bottle neck and the materials necessary to make it

of the bottle and use a tight fastener.

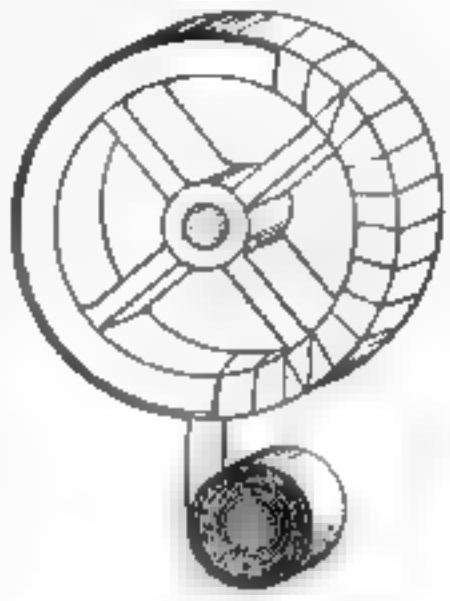
To use the cap, place it in position on the milk bottle and revolve the spring clip around the neck of the bottle, uncovering the holes in the disk. The milk pours freely from the large hole, while the other hole admits air.

How to Lighten the Finish on Woodwork

IN treating woodwork to match another finish, it is frequently difficult to secure the right effect. If the woodwork is too dark, oxalic acid, diluted in water and applied with a cloth, will produce the desired result. It should be sandpapered before it has completely dried, with No. 1, and after completely drying, with No. ½. This method holds equally good in acid and water-stain. If varnish has been applied, it must be removed by a varnish remover (adelite), otherwise the oxalic acid will have no effect.

Repairing Worn Wheels of a Carpet-Sweeper

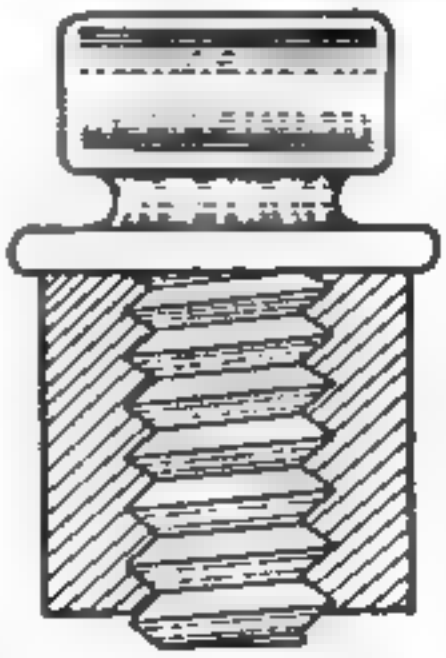
THE revolving brush of the ordinary carpet-sweeper is driven by the friction of the wheels on which the sweeper runs against driving wheels on either end of the brush axle. To insure good friction the peripheries of all of these wheels are covered with tightly fitting rubber rings. In time these rings wear out, or the rubber becomes hardened and loses it grip.



Adhesive tape on a sweeper-wheel

An efficient method of repairing a sweeper having imperfect or worn rubber rings is to cover the wheels with common electricians' tape such as is employed for covering joints in wire. The tape should first be wound around the periphery of the wheel until a covering nearly equal to the thickness of the original ring is attained. This should then be secured in place by passing the tape around the ring and between the spokes of the wheels. The gripping power of the tape is fully equal to that of the original rubber rings, and the sweeper will be good for service until other parts wear out.—GEORGE H. HALL.

A Bottle-Stopper Made of Glass and Rubber

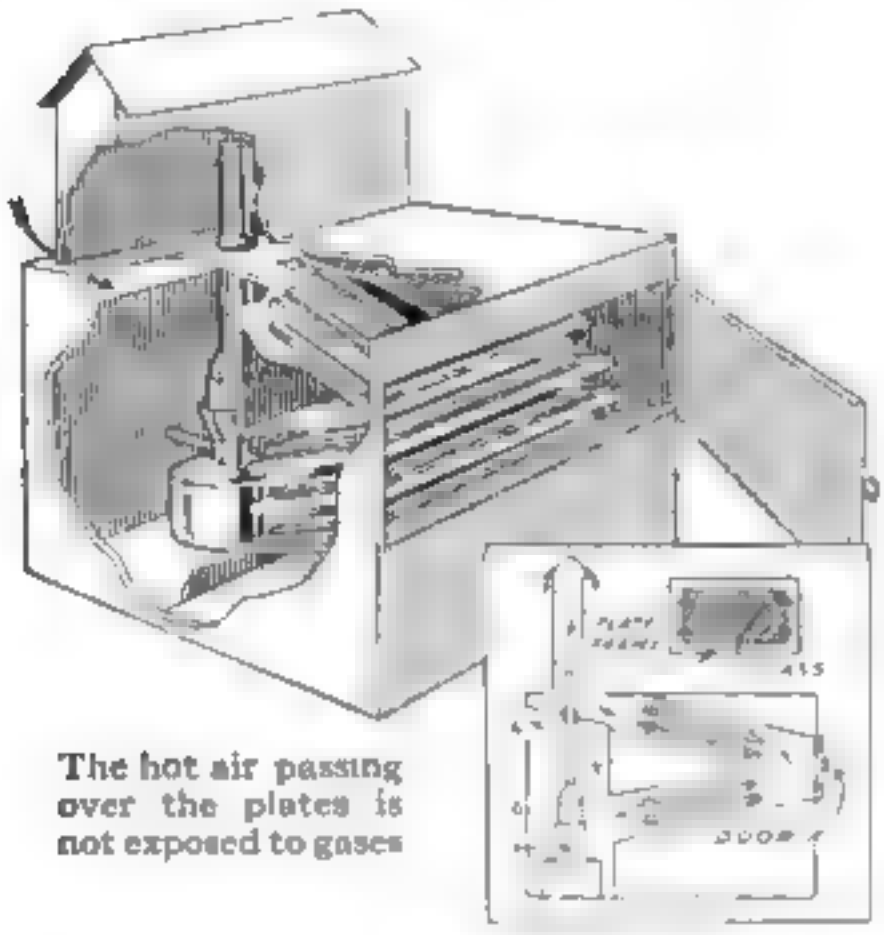


The glass part is threaded to screw into the rubber

A NEW stopper for bottles is composed of glass and rubber. The glass part is in reality a small stopper, threaded to screw into the rubber. It has a narrow flange above the rubber, and ends in a flat key-like knob for turning. When fitted into the bottle, a turn or two tightens it.

Drying Negatives by Heat from a Kerosene Lamp

THE invention illustrated is a simple lamp heater for quickly drying photographic plates. In the old form of lamp heater, the hot air from the lamp is made to circulate in a chamber con-



The hot air passing over the plates is not exposed to gases

taining the plates, but this exposes the plates to the gases formed by the combustion of the lamp and also to smoke, especially if, as often happens, the lamp does not burn well. In the new makeup, care is taken that the plates are exposed only to fresh air. As will be seen, the lamp is placed in the sheet-iron box, but it occupies a separate chamber. The lamp chimney projects up into a tube portion, and is prevented from overheating the metal by the use of an asbestos packing. The photographic plates are placed in two inclined chambers which open into the lamp chamber. The action of the lamp causes a suction in the upper tube due to the rising current of hot air, and this causes air to be drawn into the front opening *A*. The air passes up through the two plate chambers and out through the chimney. Only fresh air circulates in the plate chambers. Plates are first put in metal frames and these are slid into racks inside the chamber through the end door. If desired, a ruby glass front can be used at *G* so as to make the device useful as a dark-room lantern.

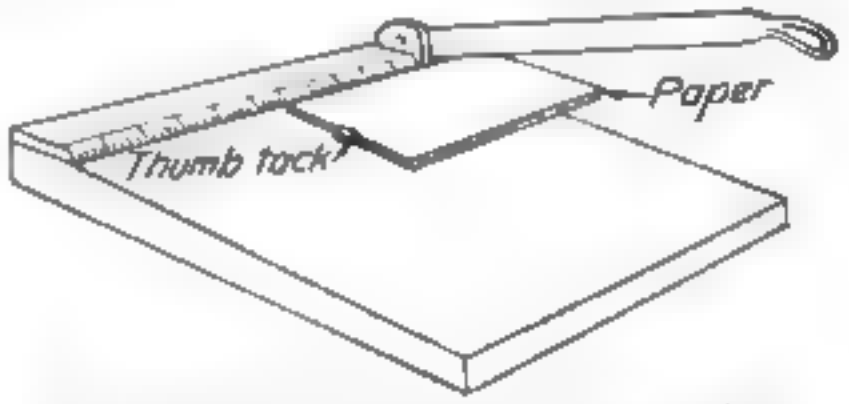
Making a Scrap-Book Out of Old Ledger Covers

A SCRAP-BOOK can be made at home from an old ledger back, paper, twine, and glue, as follows: Take an old ledger and remove from it all pages, saving only the back. Next take about one hundred sheets of heavy typewriter paper (the number depends on the thickness of the ledger) and cut these to a size a little smaller than the back of the ledger. Between each of the pages place a thin strip of cardboard about ½ in. wide. Now take some sharp instrument, such as a large darning needle, and punch holes through the edge of the sheets of paper that contain the thin strips of cardboard. Place these holes about 2 in. apart. After they have been made, thread the needle with twine and sew them loosely together by passing the needle and thread in and out of the holes you have punched.

When the sheets are fastened together take a piece of linen cloth as long as the sheets of paper and about 4 in. in width. Where they have been fastened together wet the edge with glue and press it in the center of the cloth. After it has dried put the sheets in the ledger cover and fasten it there by gluing the cloth that extends out on each side of the sheets to the inside of the ledger cover. When it is thoroughly dried you have a scrap book that has cost you little or nothing.

A Thumb-Tack Gage for a Paper-Cutting Board

THE drawing shows an accurate and easily applied method of gaging a cutting-board to trim exactly to size any number of sheets. It consists of a



The thumb-tack can be set at any desired point on the cutting board for a gage

thumb-tack stuck into the cutting-board surface at the right spot to hold the edge of the paper in place.—G. P. LEHMANN.

A Photographic Printing-Box for Use with Electric Current

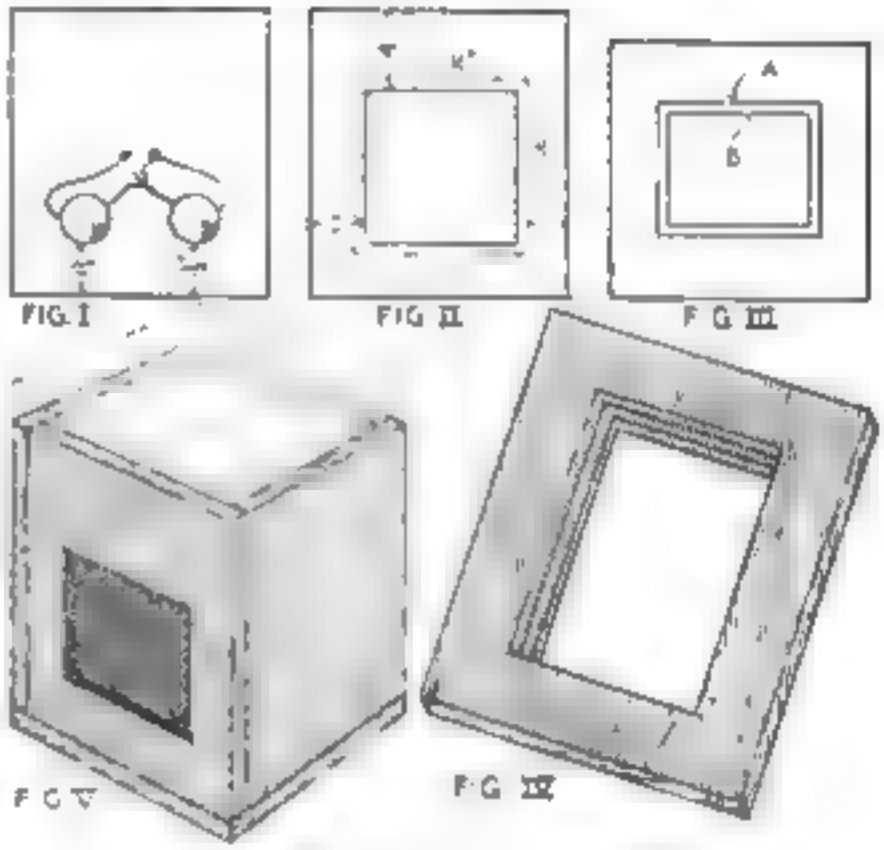
TWO of the chief difficulties confronting the amateur photographer are getting a light just right for printing, and coloring glass a ruby which will not spoil plates or films during development. To overcome these I constructed a printing-box which worked very well. Of course, it can be used only where there is electric current.

Procure four boards 14 in. long, 12 in. wide and ½ in. thick. On one of these boards fasten two lamp sockets as shown in Fig. 1. Make the connections as shown, letting the two cords pass through holes in the board to the underside. In another of the boards an 8-in. square hole is cut, which is located by the dimensions given in Fig. 2. This hole is covered with a ruby glass 9 in. square, glued, pasted or fastened with strips of wood to make it entirely light-tight around the edges. These two boards serve as front and back; the other two are for the sides of the finished box. All of them are nailed together with brads to form a box with overlapping joints at the corners.

The top consists of a board 12½ in. square and ¾ in. thick. The printing frame is placed on the center of this board and marked around the outside, making the outside line shown at *A*, Fig. 3. The frame is then removed and a line drawn ¼ in. inside as at *B*, which is used to cut out the opening necessary for the printing window. Cut halfway through the board on the lines *A* to make it appear as shown in Fig. 4. This recess is for the printing frame to rest in during exposure. Secure another board 12½ in. square for the bottom and nail it in place, as well as the top board, to form the box, Fig. 5.

Paint the box a dead black on the inside and insert the electric lamps in the sockets. Connect the ends of the wires extending from the lamps to a lamp socket with a cord and plug, and the box is ready for use. It is best to have a switch in the circuit for turning the light on and off while changing papers from the frame. The hole in the top of the box is covered with some light-proof material, such as a cardboard or a book, when using it in the dark-room for the purpose of developing negatives.

To use the box for making prints, place the negative and printing-out paper in the printing frame in the usual manner and drop the frame in the



An easily made box for exposing developing papers; also for a dark-room lantern

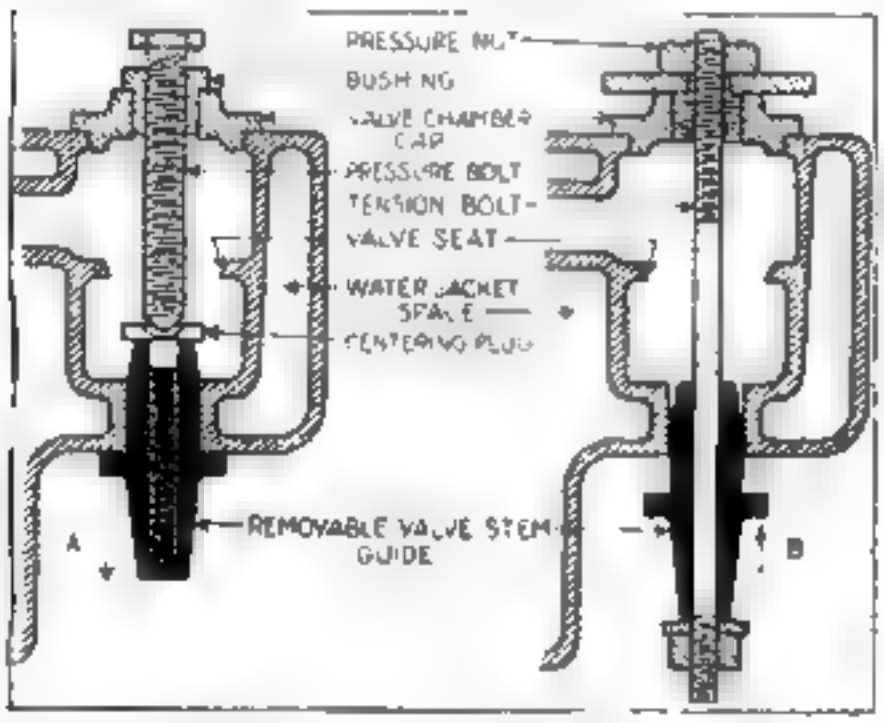
recess cut out for it in the top board; then turn on the light by means of the switch. The time required to expose the print is found after repeated trials. By using a timing device one print may be developed while another is exposing.—HARRY WILSON.

A Scheme for Keeping Pictures Hanging Straight

IF two pieces of rubber are secured to the lower ends of a picture it will prevent it from assuming different angles on the wall when a jar tends to move it from its proper position. The pieces of rubber act as a frictional break and are effective in holding the picture steady.

Removing and Applying Valve-Stem Guides by Pressure

AFTER an automobile engine has been in use for a time, the guides or bearings for the valve-stems depreciate to such an extent that there is appreciable looseness between the valve and its bearing. This not only results in noisy action but also interferes with proper engine operation, because air leaks in on the suction stroke through the inlet valve guides, dilutes the mixture and makes for unsteady engine operation at low speeds. On well designed engines, the valve-stem guides are removable and new ones can be easily inserted in place of the worn members.



Pushing the valve-stem guide out of its place by screwing down a pressure bolt

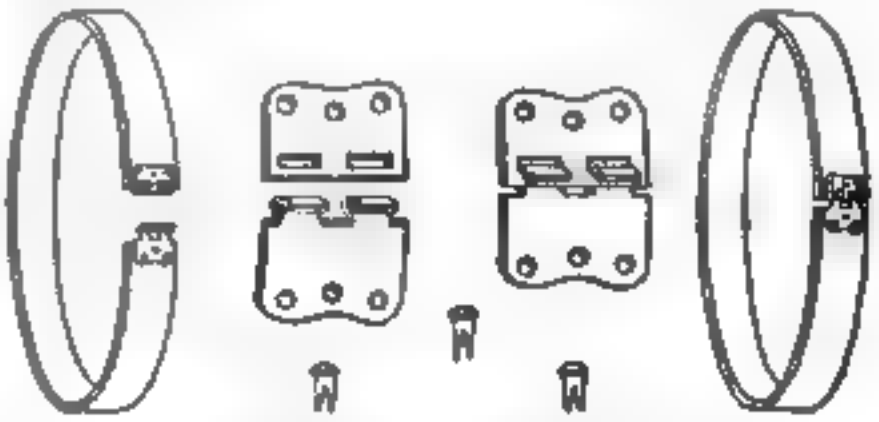
A simple and effective method of removing is illustrated at *A*. The valve-chamber cap carrying the spark-plug is used as a basis for the device. A bushing to replace the spark-plug is screwed into the cap, this being tapped out for as large a bolt as possible. If the spark-plugs are ½-in. standard pipe size, a ⅝-in. or 7/16-in. bolt can be used to advantage. The bushing is easily forced out by pressure obtained by screwing down the bolt. This is superior to the ordinary method of driving the bushings out with a drift, because the seating or casting may be damaged by a careless blow of the hammer.

The method of applying the new guide is outlined at *B* in the accompanying illustration. A long bolt, the size of the valve-stem is used as a tension screw, this passing through a piece of steel or iron bar resting on the valve-cap. Pressure applied against the guide by either the top or bottom nut will draw the bushing in place in the cylinder-casting without injuring it. The usual method followed of driving the bushing in is apt to result in breaking that member. While a lead or copper hammer is not so apt to mar the surface as the steel hammers are, still there is always danger of breaking the bushings. This is entirely eliminated by the forcing in process.

Quickly Adjustable Automobile Fan-Belt Fasteners

A NEW type of automobile fan-belt fastener has just been brought out. It is quickly attached, adjusted or repaired. The fastener consists of two metal parts, each attached to one end of the belt by means of three small brads. One metal part, the male, has two curved hooks which are slipped into two corresponding slots cut in the female half to make the belt continuous.

The fasteners are used with a special fabric belt and may be attached in a few minutes by means of the small brads. If the belt works loose on the pulleys, it may be taken off in a few seconds simply by unhooking the fasteners, whereas with a laced leather belt this takes several minutes and is a disagreeable job if one has to lean over a hot engine that has been running for several hours. To adjust the loose belt, the three brads of one of the fasteners must be removed, the fastener itself moved back a short distance on the belt and the brads pushed through the belt at other points.

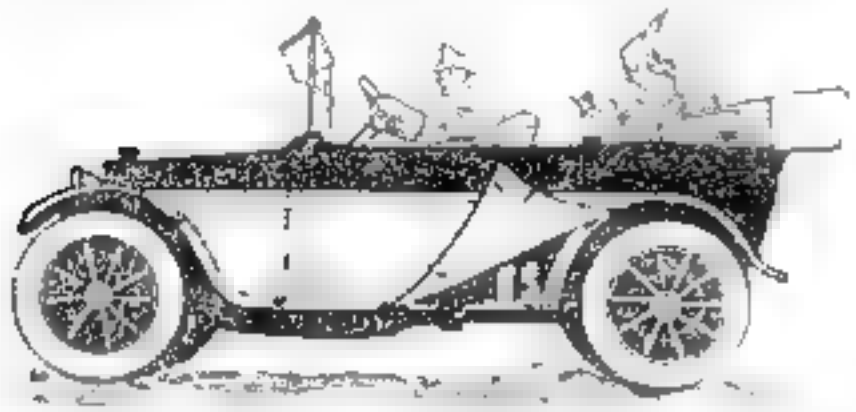


Any length of belt can be made up and adjusted by the use of the fasteners

The fasteners are made of cold rolled steel, the hooks being heat-treated but not made brittle, while the female fastener is left soft.

Loading Small Luggage on the Outside of the Car

A CONVENIENT "carry-all" may be constructed in the following manner and attached to any automobile Obtain two strips of board 1-in. thick and 2-in. wide and cut them to the shape of the front and back fenders respectively.



The carry-all takes up the space on the running board on the left of the car

Then purchase 20 ft. of blind stop and from that make a frame as indicated by the dotted lines in the illustration. This frame should be covered with black fiber board on the outside.

Drill six ¼-in. holes through the frame and then holding the frame up to the proper position on the car, drill corresponding holes in the shoulders on the fenders and running boards on the left-hand side of the car. This leaves the "sidewalk" side of the car free for entrance. The holes are practically invisible when the "carry-all" is removed. Six 3/16-in. stove bolts 2 in. long with split washers complete the device which gives sufficient room to store luggage. Camp equipment for ten people can be carried without loading the inside of the car.

A black oilcloth tucked in over the equipment keeps rain and dust from the contents and takes away the "bag and baggage" appearance. It requires only five minutes to take off or put on the frame.

Its cost is as follows:

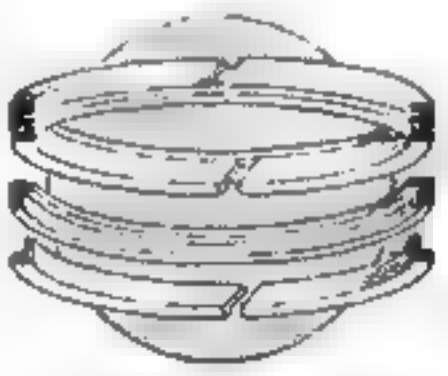
2 curved pieces and blind stop..	$.40
Covering by trunk maker.....	1.00
6 stove bolts.....	.05
Total.. . . .	$1.45

It takes about two hours to make it. The entire contrivance can scarcely be noticed at a short distance from the automobile. A large quantity of duffel can be carried in it where it may be easily obtained when wanted.

How Piston-Ring Defects Have Been Overcome

THE highly successful behavior of the average automobile and motor-boat engine is due in large degree to the present state of development of the piston-ring. The function of the piston-ring is to form a vapor-tight chamber in which gas may explode, impounding its freed energy upon the piston-head which transmits this energy to the working parts of the engine. It is evident that the piston-rings must be as vapor-tight as it is possible to make them.

The earliest type of piston-ring was round, of the same thickness throughout, and was slotted to allow for expansion and contraction of the engine as it became hot or cold. The concentric ring was soon followed by the eccentric ring. The eccentric ring had a slot similar to the concentric type, but it overcame one of the defects of the older type—an unequal distribution of friction against the cylinder-wall. This was accomplished by tapering the thickness of the ring to the point at which the slot was cut. In overcoming the defects of the concentric ring, however, the eccentric ring acquired disadvantages almost as undesirable. One of these was that the unequal thickness of parts of the ring caused carbon to collect in the grooves on the piston-head into which the rings fitted. The great disadvantage of both these types of ring was their loss of energy, which resulted in their inefficiency. High compression was impossible, as the gas would escape rapidly into the crank case below the cylinder. This defect, together with the undesirable features of the two types of rings, has been overcome in a new ring that is now in use. Two of the eccentric-type rings are grooved in such a way that they fit each other perfectly. Vapor cannot escape through either slot because a thin steel wall prevents it. Consequently, while the compression is high, the friction is equally distributed and the wear reduced.

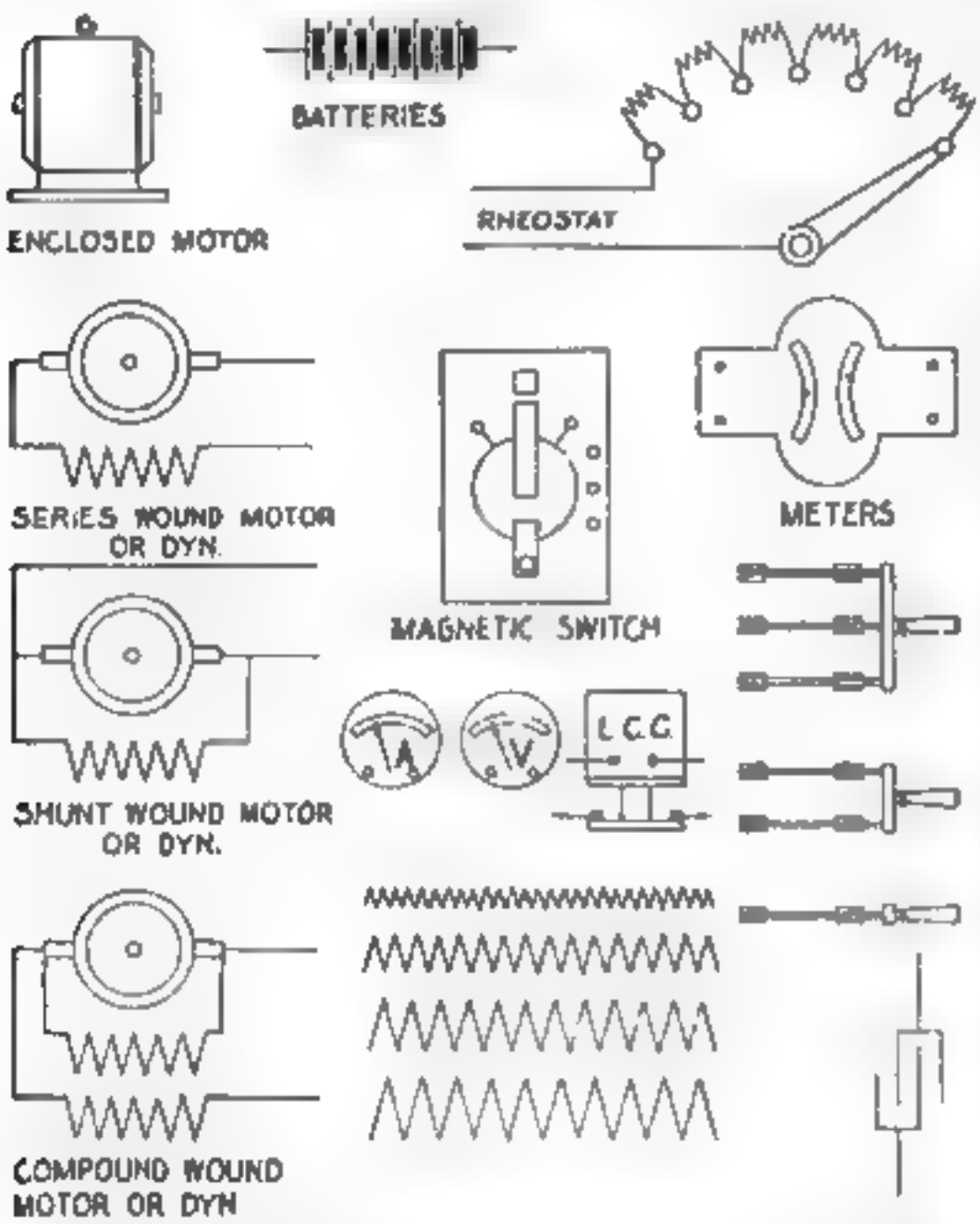


The rings are grooved to fit perfectly

A Simple Tracing Method for Electrical Draftsmen

A TIME-SAVER for electrical draftsmen is shown herewith. The idea is to draw standard details on a paper, or still better, on a tracing cloth template, repeating each figure to each of the standard scales used in the office.

When these figures occur in tracing a drawing, the template is slipped under the tracing cloth so as to bring the proper figure, drawn to the proper scale, into position, when it is traced direct, saving the time necessary to make a scale drawing of that particular symbol. This idea may be extended as far as profitable, as the templates can be made up as a filler job.—FRANK HARAZIM



'Stock drawings or templates to slip under tracing cloth as an aid in drawing in machine parts

---

A Table-Mat That is Both Decorative and Protective

AN ingenious device for table-mats is an embroidered linen slip, inside of which is placed a sheet of white asbestos.

Lightening Automobiles with Aluminum

THE most pronounced tendency in connection with modern automobile development is the reduction of car weight that has been made by all leading manufacturers in their recent models. One way of lightening the power-plant is to use small cylinders and obtain the power desired by increasing the piston speed and, of course, the number of explosions in a given time. The experimental work done in connection with high-speed motor design brought out the desirability of using light reciprocating parts. To attain this end, aluminum-alloy pistons were tried instead of cast-iron and these have been so successful that many new engines will be equipped with pistons of the lighter metal. Aluminum parts weigh about one-third as much as cast-iron ones of the same size, so the reduction of reciprocating weight materially reduces vibration and makes higher speeds possible.

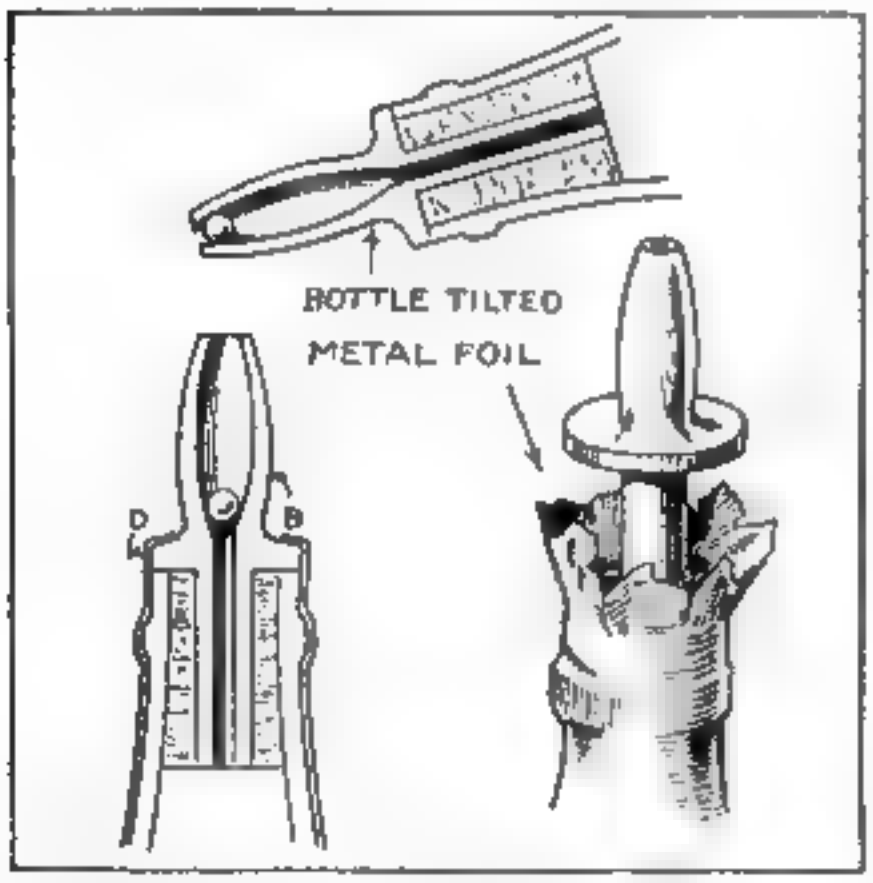
All of the higher grade engines have always used aluminum crank-cases, but it remained for an ingenious designer to use aluminum for his cylinder-block casting in a 1916 power-plant. This engine is the nearest approach to the aluminum motor that has ever been made, since every part that could be made of that material has been constructed in some alloy of it.

Of course, there are numerous parts where it is not possible or practical to use aluminum. The crank-shaft, cam-shaft and connecting rods, for instance, must be of steel and very excellent metal at that. The valves and wristpins must be of steel and the fly-wheel of steel or cast-iron, because this part must be heavy to be effective. In this engine, even the cylinder-head casting is made of aluminum, the valves seating on cast-iron valve seats, made solid in the casting by the ingenious process of placing them in the mold and pouring the molten metal around them, when the cylinder-head is cast. The valve-stem guides are

of cast-iron, pressed into the head casting; the piston-rings are also of that material. The heaviest parts made of aluminum are the pistons, cylinder-block, cylinder-head and crank-case. The pump, water connections, valve-motion cover and fan are also of aluminum. The valve-actuating rocker-arms are aluminum-alloy die-castings, the tappet-rods are also of aluminum alloy. Since aluminum is a soft metal, it would not be practical to run pistons of that material in cylinders of the same kind, so accurately machined cast-iron cylinder liners are pressed into the cylinder-casting to guide the pistons. An engine of this kind will weigh considerably less than one of the same size made entirely of cast-iron and steel, it being possible to save several hundred pounds' weight without any sacrifice of strength in an engine of fifty horsepower.

A Bottle-Stopper Which Controls the Outpour

A VERY good makeup for a special bottle-stopper intended to let out only a small portion of liquid such as perfume or the like, at a time, is shown here. It also makes it impossible for the stopper to be removed without

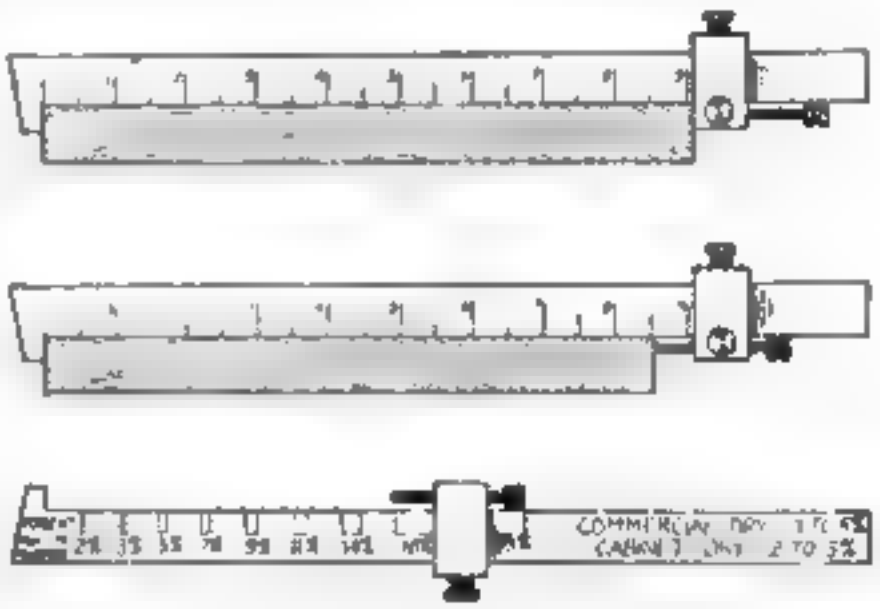


The ball within the stopper allows only a small portion of the liquid to pass out

detection. Into the cork portion *A* is fitted the metal part *B* which has a flanged portion so as to cover all the top surface of the cork. The end is made as represented, the ball being placed inside in order to prevent escape of the liquid except in small portions. A cap of metal foil fits over the neck of the bottle and the upper flanged part of the stopper, so that to remove the latter necessitates breaking the metal foil.

A Gage Which Tells the Amount of Moisture in Wood

A GAGE that ascertains with accuracy the amount of water present in lumber has been put on the market. In



Gage used to determine the amount of shrinkage in wood in process of drying

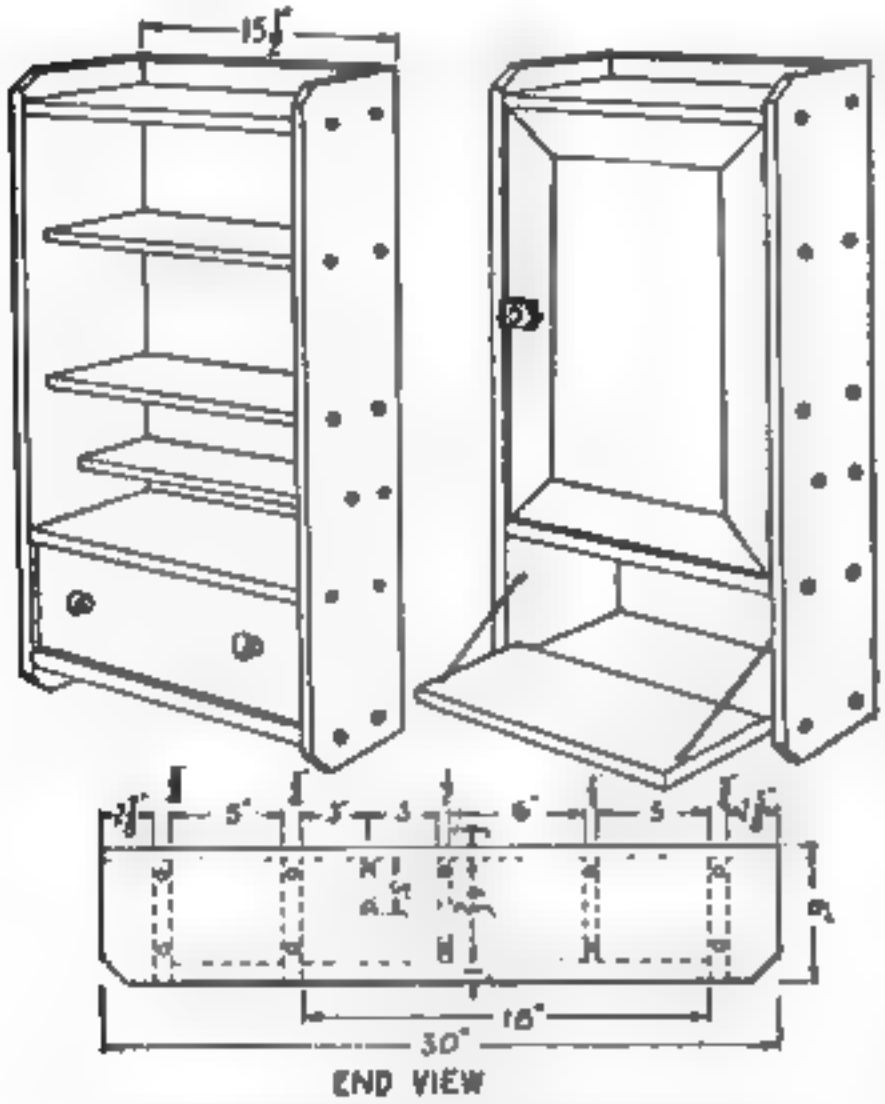
appearance it closely resembles other commoner forms of gages used for other purposes, but its markings are different. A section of the wood to be tested is cut from the lumber and placed between the gage-jaws. The sample is then removed and thoroughly dried in a kiln. When the sample comes back from the kiln, it is again measured and the amount of shrinkage is noted.

Mending Picture Frames with Laundry Soap

A PICTURE may often be bought at a reduction in price because of a damaged frame. A badly marred or chipped frame can be easily and effectually mended with common brown laundry soap. Fill in the portions broken away with the soap, which can be molded with the fingers into any desired shape. Let it dry thoroughly and it will be as hard and strong as it is necessary for it to be. Gild or paint as the case requires, and the frame will look like new. —JENNIE E. MCCOY.

An Easily Made Bathroom Cabinet and Medicine Chest

THE simple construction of this cabinet will recommend it to those who would take pride in making some useful piece of household furniture, but



Medicine cabinet with mirror and drawer for toilet articles for the bathroom

who because of lack of skill have not attempted the articles designed for the experienced craftsman. It is made of oak. The pieces may be ordered from a planing mill planed, sandpapered and cut into the desired lengths. The mirror door is a standard size framed mirror, which can be purchased at any department store.

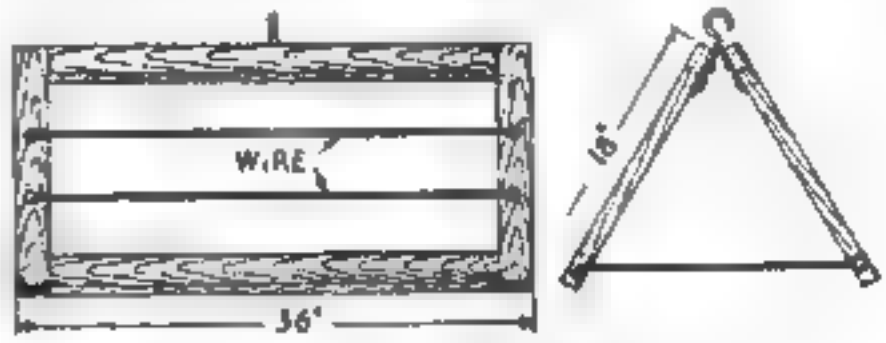
The upper or main cabinet is partitioned for medicines by two full-width shelves and one half-width shelf. Below the main cabinet there is a compartment for toilet articles. The front of this compartment is hinged to the bottom and lets down to form a shelf on which to rest the shaving mug or other toilet accessories. This front or door is provided with a small drawer-lock. The two knobs are added to relieve the plainness.

The following materials are required to make the cabinet: 3 pcs. ¾"x5½"x14," top, bottom and bottom shelf; 2 pcs. ½"x4½"x14", upper shelves; 1 pc. ½"x3"x14", lower shelf; 2 pcs. ¾"x6"x30", sides; 1 pc. ½"x14"x30", back; 1 mirror, framed, 14"x18"; 1 pc. ¾"x5"x14" front of lower compartment; 1 cupboard-catch for mirror door; 1 pr. 1½" butt-hinges for mirror door; 1 pr. 1¼" butt-hinges for lower door; 2 small wooden knobs for lower door; 1 small drawer-lock for lower door; 2 pcs. of dog chain for lower door.

The cabinet is put together with 1¼" round head blued screws; 46 are required, 22 to attach sides to shelves, top, and bottom, 8 for sides to back and 18 for back to shelves, top and bottom. The easiest way to assemble the cabinet is to tack the back to the shelves, top and bottom, using small nails, two in each This will hold them in place while boring the holes and setting the screws Then screw sides to back, shelves, top and bottom, boring ⅛-in. hole for each screw. Then hang the two doors and finish with a stain.—T. H. LINTHICUM

A Clothes-Rack for Use Indoors and Outdoors

A GOOD clothes-rack for use in the house can also be hung over the line out of doors. It is made out of a few large galvanized wires and some light strips of wood. A pair of ordinary hinges may be used to hold the two parts together or a joint may be made like the one in the drawing, with a long wire and a half dozen screw-eyes. Half-inch lumber an inch and a half wide is strong enough for the frame. The dimensions should be about 18 by 36 ins. for each side. This will give 24 ft. of drying space, nearly as much as the ordinary clothes-horse which sits on the floor and



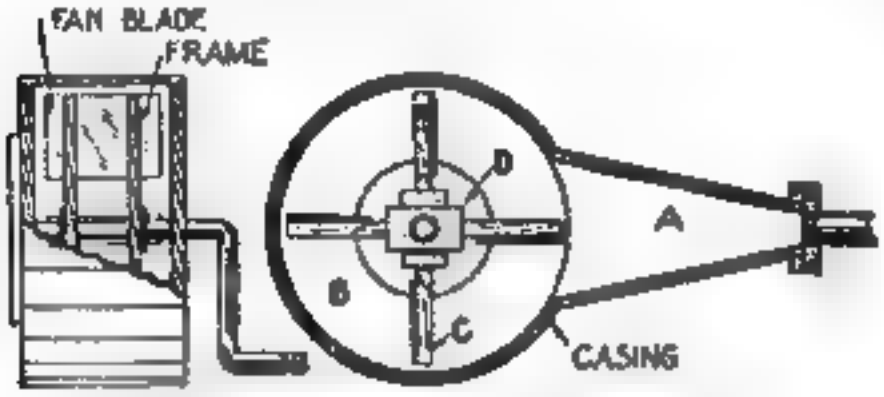
A V-shaped back for hanging laundered articles where there is a limited space

takes up more room. A screw-hook secured in the middle top enables it to be hung up in the house when full of articles to dry.—PAUL R. STRAIN.

A Blacksmith's Hand-Blower Made of Wood

A WOODEN blower for a forge is something of a novelty. A reader in the southwest sends us the accompanying drawing.

In the drawing *A* is the nozzle, *B* is the fan-casing proper, which might very



A large hand-blower made of wood for use in connection with a blacksmith's forge

easily be a cheese-box. The fan-blade and frame are shown at *C*. *D* is the opening in one side of the fan-casing for the air supply. It has a batten across it to support the shaft on which the fans are fixed. This shaft has a crank for turning. The apparatus is cheap and practical, as a sheet-iron or wrought-iron pipe connection can be made between the blower and forge.

On account of the absence of multiplying gearing, the blower should be made several times larger than the geared blowers so common on portable forges. The dimensions and proportions, however, will have to suit the individual requirements.—LESTER SMART.

Four Good Recipes for Acid-Proof Cements

AN excellent recipe for an acid-proof cement contains the following ingredients:

Crude, finely cut rubber	1 part by weight
Linseed oil, boiled	4 parts by weight
Fire-clay	6 parts by weight

Another equally satisfactory mixture requires the following materials:

Rosin	1 part by weight
Sulphur	1 part by weight
Fire-clay	2 parts by weight

The following mixture will resist all acid vapors (even nitric acid):

Litharge	80 lbs.
Red lead	8 lbs.
Flock asbestos	10 lbs.

These substances should be fed into a mixer, a little at a time, with 6 quarts of boiled linseed oil.

A good cement for dilute hydrochloric acid is the following:

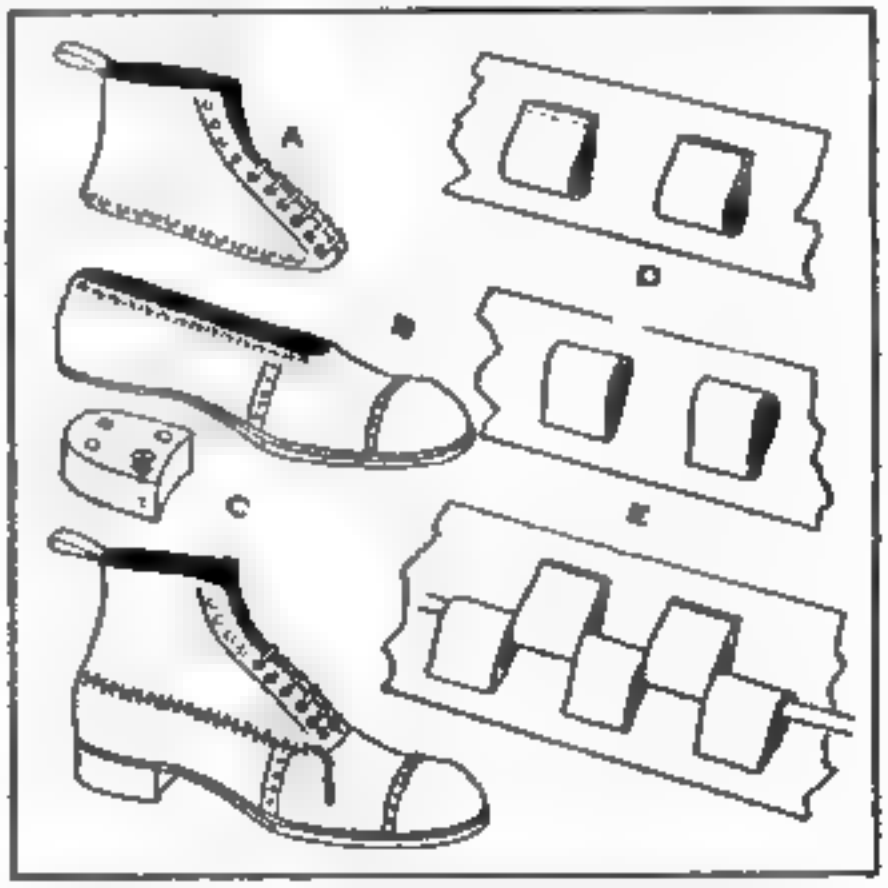
White China clay	1 part by volume
Fine white sand, or powdered quartz and sand	2 parts by volume

Mix the ingredients thoroughly, working them up with just enough silicate of soda, diluted with an equal volume of water, to make a paste. If a little fine casein is added to the silicate of soda, the mixture will be smoother.

To Convert a Pair of Shoes into Slippers

THE shoe illustrated has three separate parts, the upper *A*, body *B*, and heel *C*. To form the complete shoe, the heel is screwed on by the use of four screws. In order to attach the upper, there is used a set of lugs *D*, spaced all along the edge and these correspond to a similar set of lugs *E* on the body of the shoe.

The upper set of lugs fit exactly into the spaces between the lower ones, and a leather or any suitable lace is run the entire length of the shoe with the two ends brought out in front. The remainder goes through the eyelets in the upper. Again, when a slipper or low shoe is wanted all that is required is to take off the upper and the heel.—F. P. MANN.



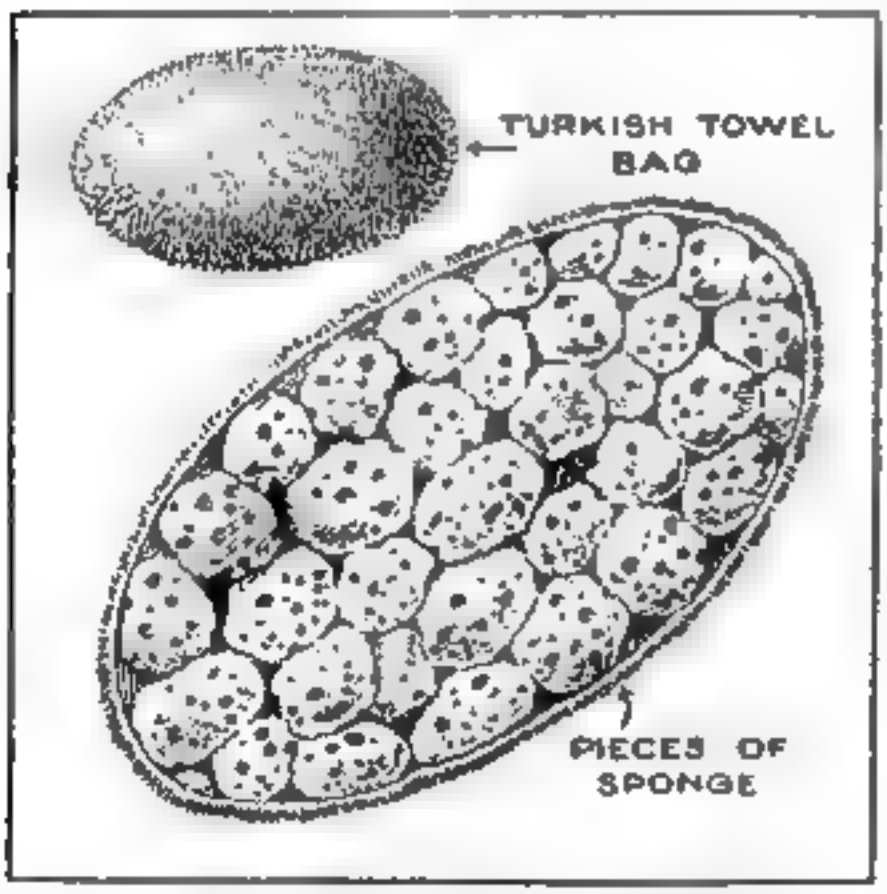
The heels may be unscrewed and the tops taken off or put on whenever desired

Improved Method for Decorative Glass Blowing

A RECENT French patent describes an improved method for blowing glass in molds, so as to obtain ornaments in relief upon the surface of the object. A form having the shape of the bottle or vase has the decoration put on in wax; then it is covered by a suitable molding substance. By heating in the oven, the wax runs out, leaving the impression in the hardened mold. Then the glass is blown into the hollow mold, and the glass now takes the shape of the cavities so as to stand out in relief. The mold is carefully broken off the glass, and the design appears in sharp relief.

What to Do with Small Pieces of Bath Sponge

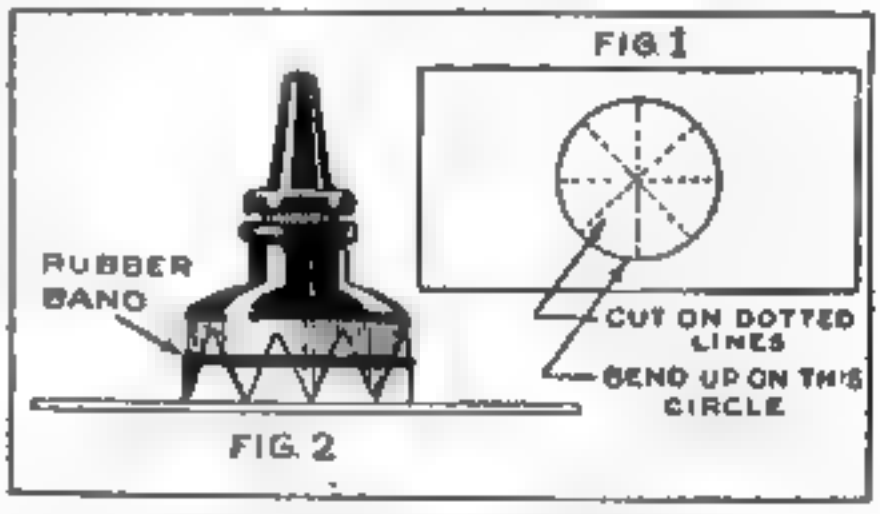
HERE is a small economy for cleanliness and comfort in the bath. As is well known, large sponges soon break up and become useless, and again they are subject to being clogged up by impurities which are now recognized to be due to microbe growth within the sponge. This is difficult to remedy in the case of a large sponge. A new idea is to assemble small pieces of sponge in a bag so as to give about the same shape as an original large sponge. The bag can be made of Turkish toweling or any suitable material. Thus all small pieces of sponge can be utilized and can be kept clean easily.



A bag made of Turkish toweling for inclosing sponges to prevent their clogging

A Draftsman's Inkstand Which Will not Overturn

A ROVING ink-bottle on a drafting-table is a treacherous thing. To keep it from turning over, take a piece of tin or cardboard 3 in. wide and 5 in. long, cut as shown in the drawing, and bend up the tips. Push the bottle up into this circular grip, and the tin tips will hold it securely. If cardboard is used, put a rubber band around the tips. The bottle will be held securely and cannot be accidentally overturned.



The stand holds the ink-bottle in an upright position and prevents it from tipping

Renovating Nickel Plate with Tinfoil and Solder

WHEN touching up worn or rusted nickel parts, first remove all rust and dirt with a file or emery cloth. Heat the surface and cover it with a soldering flux. When sufficiently hot, rub a stick of solder or some pieces of tinfoil over it, until it is thoroughly tinned. After cooling, the surface may be smoothed up with fine emery paper and a piece of flannel.

This method may be used successfully on motorcycle handlebars. It is hard to tell the difference between the lead and nickel, when the work is properly done, and the lead will wear longer.

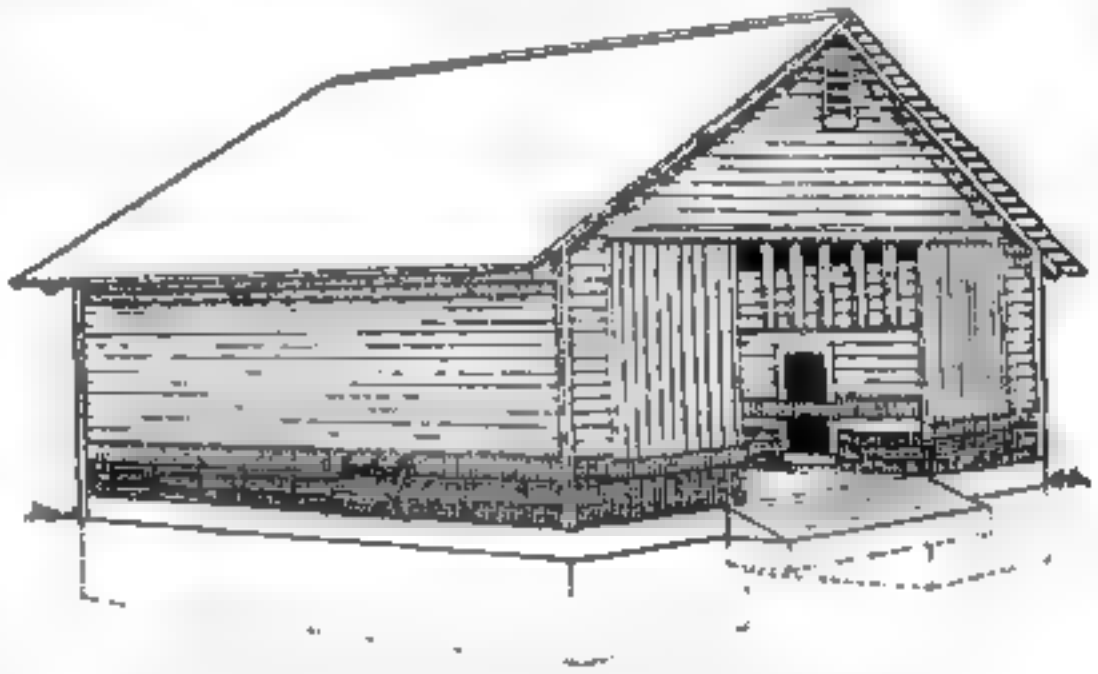
Keeping Rats Out of the Corn-Crib

SPECIALISTS in rural engineering have worked out plans for a corn-crib that will aid in the drying of corn and protect it from the rats. There are usually two cribs in the complete structure, each 32 ft. long by 8 ft. wide, with a capacity of 1,000 bushels each.

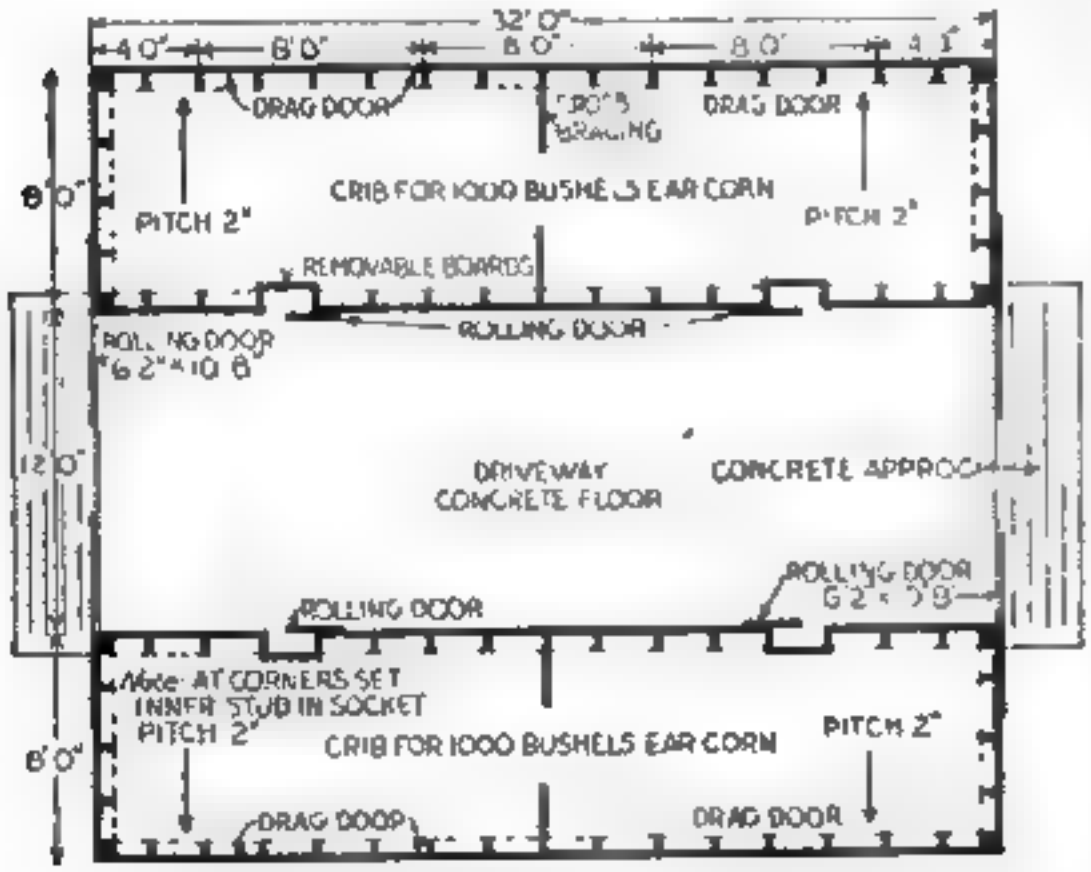
The cribs are separated by a driveway 12 ft. wide and covered by a gable roof. The driveway may be of concrete or dirt. If the ground is well drained, a dirt driveway will answer. If the floor is of concrete it will serve as a feeding floor for hogs. A wood floor would harbor rats.

A concrete foundation is put in for all the walls. This should extend from below frost line to 6 in. above ground for the outer wall and 8 in. for the inner wall. The space between the walls should be filled with well tamped cinders or gravel, and on this a concrete floor laid. The difference in height between the foundations will give a 2-in. pitch to the floor towards the outer edge and drain off water that may beat through the walls. The cinders or gravel under the floor prevent moisture rising. The crib floor should be constructed of 4-in. reinforced concrete with the surface troweled to a finish.

If a concrete driveway is used, 6 in. of gravel should be tamped down in a 4-in. floor with float finish laid on top. The iron sockets, which can be readily obtained on the market, should be set in while the concrete floor is being laid. The studs should be 2 in. by 6 in. The siding on the outer walls consists of 1-in. by 6-in. boards with upper and lower edges beveled at 45 degrees. They should be about 1½ in. apart. This permits entry of air, while the beveled edges lessen the danger of rain or snow beating in.



Double corn-crib with concrete floor, wire mesh and iron strip on lower part to keep out rats



Floor plan of the double corn-crib in which is incorporated a driveway made of concrete

The siding facing the driveway need not be beveled, as there is no necessity for protection from rain at this point, and the siding should not be carried higher than 6½ ft. This permits the crib to be filled by throwing the corn over the boards. If the quantity is sufficient to fill the crib above this point, additional siding can be hung on 20-penny nails driven into the inner side of the studs. The boards have holes at proper intervals to fit over the spikes and are held in place by the pressure of the corn.

The rat-proofing is a feature which the farmer cannot afford to neglect. Wire netting of ½-in. mesh is put on all sides of the corn between studs and siding and carried to a height of 30 in. above

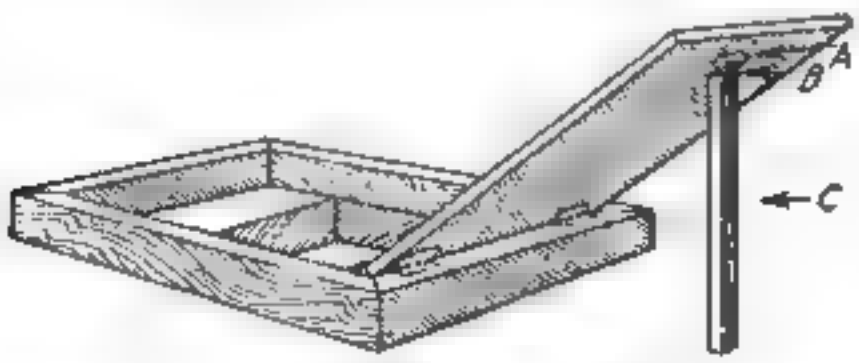
the ground or above the floor of the driveway. A strip of 8-in. galvanized iron is placed at the top of the wire and nailed to the outside of the siding. The bottom of the galvanized iron is 2 in. lower than the top of the wire, making a total height for the wire and iron strip of 36 in. all around. This strip will halt rats that may climb up the walls. The rat-proofing is put on the drive side of the cribs so that if the doors are left open rats will be unable to get at the corn. Care should be taken not to leave objects near the walls which would enable a rat to jump above the proofing

Provision is made for four drag doors on the outer side of each crib and two rolling doors on the inside. The drag doors are so designed that the corn will roll out of them on the conveyer-belt of the sheller. The rolling doors on the inside are for access to the crib. They should consist of a frame completely filled with wire netting, with a galvanized iron strip at the same height as on the wall. The drag doors are made of siding nailed to the cleats with the wire mesh between.

Movable inverted troughs of slats are placed on the floor lengthwise of the cribs. These are in sections to facilitate handling and are designed to increase the circulation of air. As a further aid to circulation, movable shafts may be placed at the side or on top of the troughs. The shafts are constructed of strips 3 in. wide by 1 in. thick nailed vertically to frames made of material 2 in. wide by 1 in. thick. To hold the shafts in place they may be nailed to the cross-ties overhead.

An Easily Constructed Support for a Trap-Door

MANY people have an out-door cellar, entrance to which is had through a trap-door. The hinges on the door usually become bent and broken in a short time, because, when the door is opened and laid back, it seldom rests on the ground. Usually it touches the door-frame, which strains the hinges and causes them to break. To avoid this, fasten a hinge (*B*) on a block (*A*) near the outside edge in the center of the door, and to this hinge fasten a stick (*C*) that will reach nearly to the other side of the door, and see that the hinge works very freely. When the door is opened and let down on its back, the stick will swing out and support the door, as shown in the drawing, so that it will not touch the frame. When the door is closed the support swings back, and lies flat on the door.



A support attached to a cellar door to prevent breaking hinges

Adjustable Overshoes to Prevent Horses from Slipping

A NEW horse overshoe has only one strap to buckle. No tools whatever are necessary. The two front links are made to tip in or out and fit any shaped hoof. Nothing projects which can possibly hurt the horse. The overshoes are made of malleable iron to prevent the calks from breaking off. The side calks prevent side-slipping entirely, so that the horse can trot with perfect safety on icy pavements.

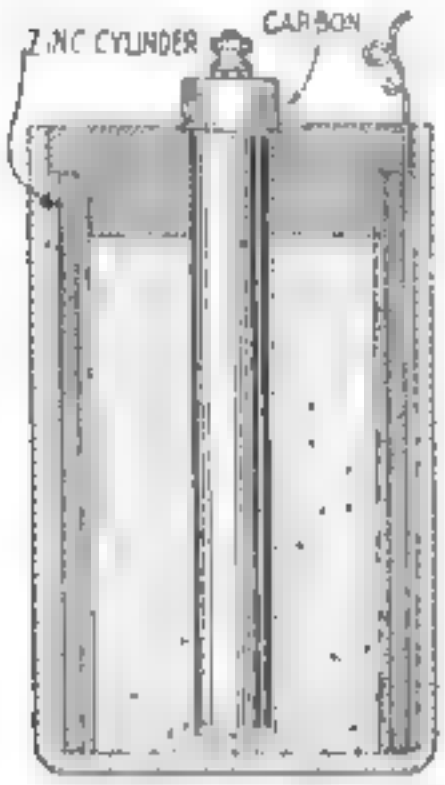
Easily fitted overshoes for a horse

The use of overshoes is particularly recommended because they can be removed at will, so that a horse is not walking or standing on sharp points when the calks are not needed. New ones can be put on with the first ice or sleet, or even used in summer weather on bad roads without first visiting a blacksmith.

FOR sanitary reasons never paint a kitchen a color to hide the dirt. A color should be used that will show every particle of dust and dirt, which will then be removed for the sake of appearance.

To Make a Dry Battery Having Lasting Qualities

FOR the person who cares to experiment, this type of a battery is a good example to try out; for, if properly constructed, it will last much longer than the ordinary dry cell. The container consists of a glass jar of a size suitable for the battery. Coil up a cylinder of heavy zinc plate to fit closely against the inner surfaces of the jar and line the inside of the zinc with a good grade of thick blotting paper.



A Home-made dry battery cell

A paste is made as follows: For the liquid mix together 3 parts water to one part muriatic acid. (In mixing acids and water remember to add the acid to the water slowly while stirring the water.) The body matter for the paste is made of four parts powdered charcoal, 2 parts flour and 1 part plaster of Paris. These parts are measured by volume. Mix this powder with the acid liquid to form a paste.

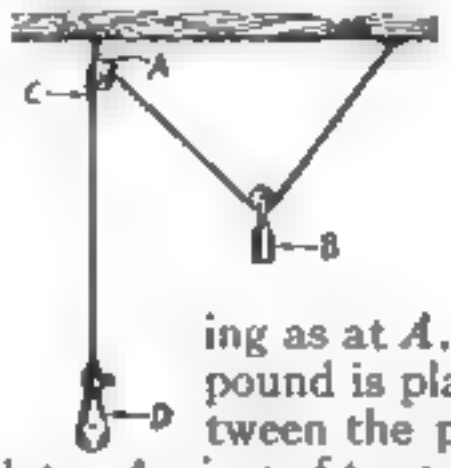
Procure a carbon from a discarded cell and place it in the center of the jar, then fill in around with the plaster to the top of the jar and finish by sealing with wax. After this stands for a few hours it will be ready for use.

Insulating the Ground Connection in Radio Work

A GOOD ground connection is of the utmost importance in radio working. If you use the gas, steam or water pipes be sure that they run out to the system of mains with good electrical conductivity. In some parts of the country it is customary to insulate gas or water pipes at the meters. Where this occurs a wire shunt should be connected between the house-pipes and the outside mains.

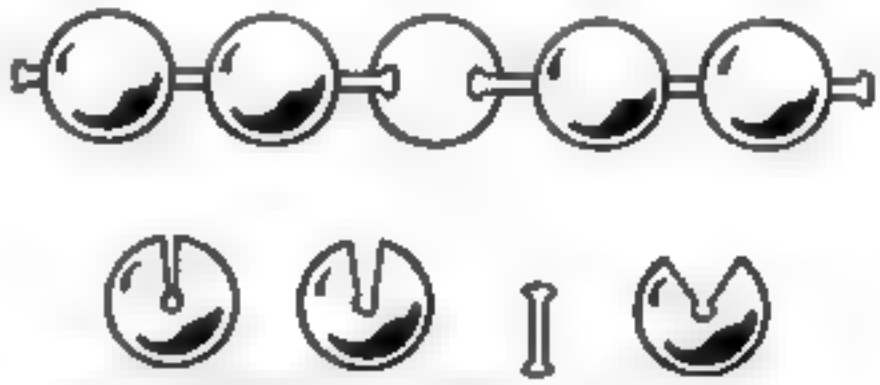
A Weight and Pulley to Adjust Flexible Lamp Cords

WHEN working around a machine it is necessary to have a portable light. A good way to make one is as follows: An electric lamp is let down from the ceiling to the floor. This wire is run through a pulley placed in the ceiling as at *A*. A weight *B* of ½ pound is placed on the wire between the pulley and the outlet. A piece of tape is then wrapped on the wire on the outside of and below the pulley at *C* to keep the lamp from going up out of reach. When the lamp is to be used under the machine, take hold of the wire above the light *D* and pull it down. Afterwards the weight *A* pulls the lamp up into its former place again.



To Lengthen a Shot-Chain on a Pull-Socket

THIS simple operation will prove to be an economy to those handling these goods. It will be found that the small balls are split. These are opened up with a knife-blade until the edge of a cold chisel will take effect. They are then further opened up to release the small pin on the inside. This pin has a head at each end. One ball must be removed so that an extra pin may be had to start the lengthening of the parts. The pins are then put in to form a part of the chain instead of being just a fastening means. To do this properly the parts are laid out on a bench, and the balls clamped over the ends of the pins with pliers.—E. B. WILLIAMS.

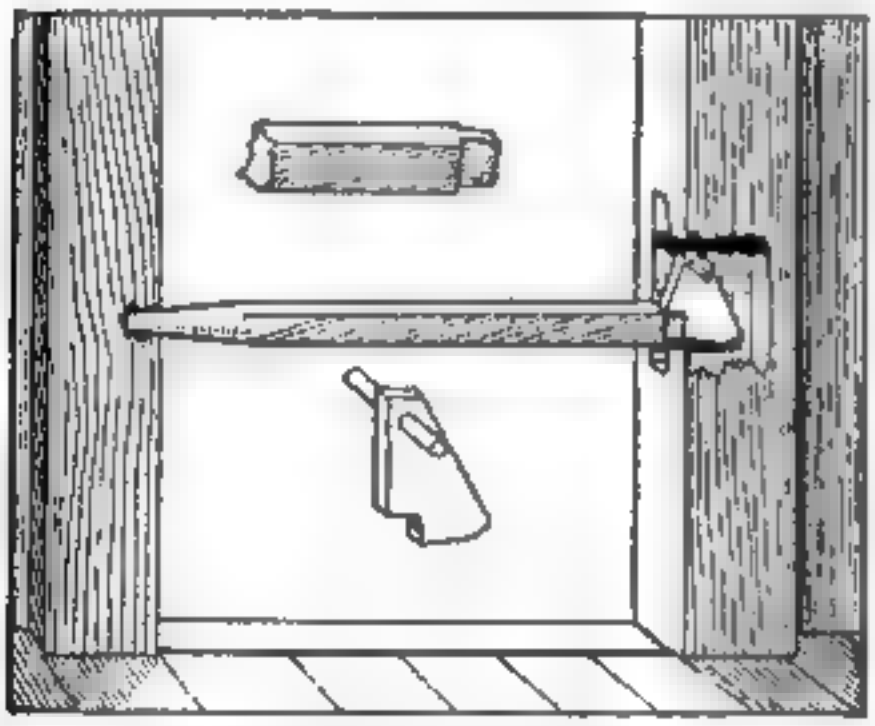

The small balls are split and may be opened up with a knife-blade and a chisel

An Easily Made Self-Locking Device for Barn-Doors

THE drawing shows a self-locking device that is very useful on barn doors to prevent large animals from entering or leaving the buildings at will.

It permits a full amount of light and air to pass the doorway, and is easily set aside when not needed.

It is made as follows: Chisel a mortise in right-hand door-post 5½ in. long, 1¼ in. wide and 4¼ in. deep. Cut a slight vertical groove over the top 1¼ in. wide. Then bore a ½-in. hole at right angles with the mortise 1 in. from the top and 1¼ in. from the front for a pin. Place a wood dog of 1-in. oak in the mortise and insert pin through the door-post and into a 9/16-in. hole in the dog, suspending it to swing freely. In the left door-post bore a 1½-in. hole to a depth of 1½ in.



A self-locking bar across the barn doorway to keep the large stock in or out

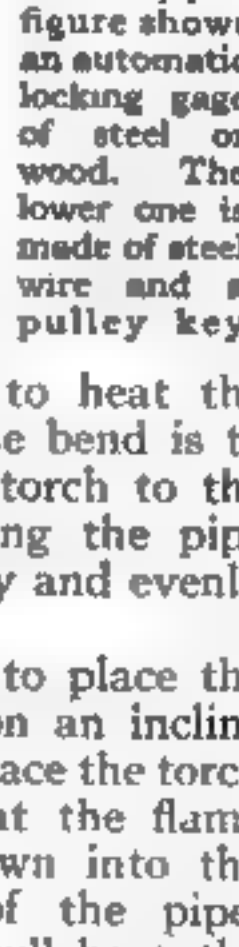
Select a bar of hardwood 2 in. by 3 in. and cut it 2½ in. longer than the exact width of the doorway. At one end make a tenon 1 in. long by 1¼ in. wide, and nearly the thickness of the bar, rounding the two corners a trifle on the upper and lower sides, that it may be easily raised and lowered. Round the opposite end of this hardwood bar to fit the 1½-in. auger hole in door-post.—GALE PINCKNEY.

Two Types of Inexpensive Depth Gages

ONE of the handiest tools for all mechanics is the depth gage. One can easily make a gage that is inexpensive as well as practical.

In the illustration the lower figure shows a simple gage made of ⅛ in. steel wire and a small pulley key; the measuring rod is locked by a small thumb screw.

The upper figure is an automatic locking gage of steel or wood, pressure on the split ends being required to release it. A small rod is split ⅞ of its length, and it is then sprung slightly so that friction is created great enough to hold it in place when in operation.—L. E. FETTER.



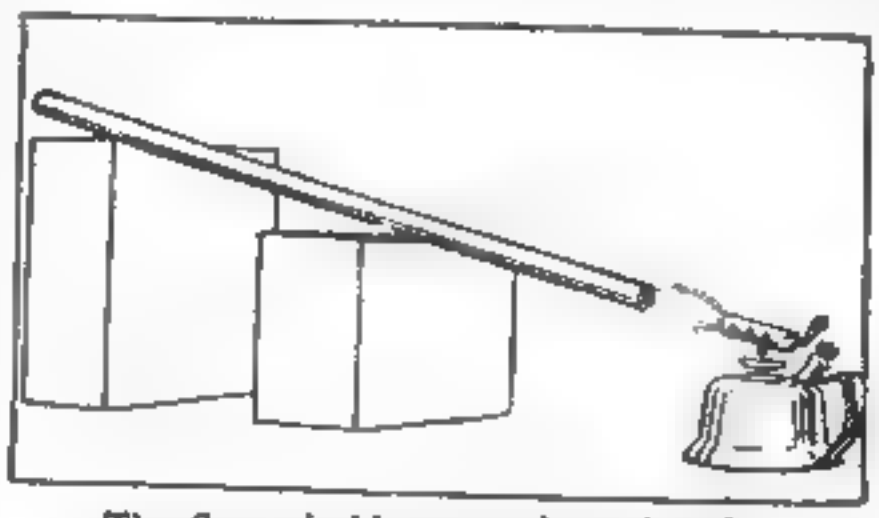
The upper figure shows an automatic locking gage of steel or wood. The lower one is made of steel wire and a pulley key

Annealing Brass Pipe for Bending

IT is usually necessary in bending brass pipe or tubing to first anneal it to prevent the metal from cracking or breaking.

The customary way is to heat the pipe at the point where the bend is to be made by applying the torch to the outside of the pipe, turning the pipe until it is heated thoroughly and evenly all around.

A still better method is to place the pipe on an incline and place the torch so that the flame is blown into the end of the pipe. This will heat the pipe evenly the full length, after which it should be dipped in water. This will give the pipe an even color over its entire length.



The flame is blown up into the pipe heating it evenly for the entire length

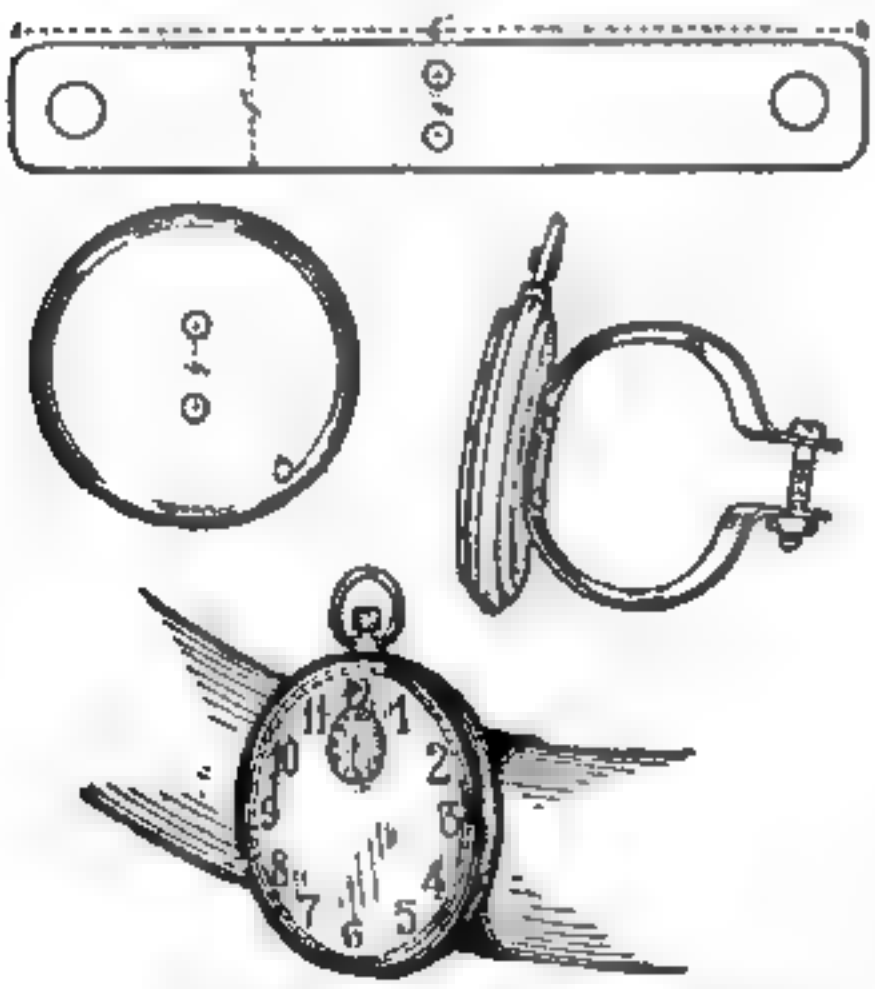
A Watch-Carrier for the Motorcycle Handlebar

EVERY motorcycle owner desires to have a watch placed on his handlebar, but the cost of a good watch-holder is entirely too expensive for the service it gives.

A thoroughly practical and easily constructed holder is made by removing the back of the watch and boring two small holes in it. A piece of nickel-plated brass or tin is then cut in a strip 1 in. wide and from 6 to 7 in. long, depending on the diameter of the bar. Two small holes are bored in the center of this piece, coinciding with those bored in the back of the watch, and out at each end to receive a bolt and nut when bent in a circular form.

This piece is then united to the watch-back and securely soldered. The watch-back is then pressed back on the watch and the metal strip curved around the handlebar and a bolt run through the two ends and tightened up, fastening it securely.

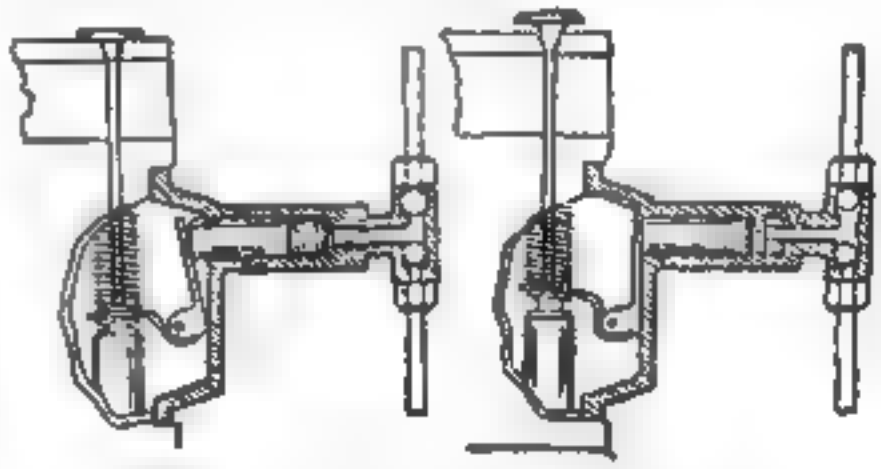
This makes a very attractive ornament on the machine, as only the watch itself is seen from the rider's seat. A little shellac or solder should be used when the watch-back is pressed on again to insure its safety.—N. S. Mc Ewen.



A metal strip is soldered to the watch and then curved around the handlebar

Operating the Oil-Pump of an Automobile by Valve Action

IT is seldom that the valves of an automobile engine are called upon to perform more than their usual function of admitting the mixture to the cylinder on the intake stroke and releasing the



The upward movement of the valve stem and a strong spring operate the piston

burnt gas on the exhaust stroke; but the manufacturer of a new sight-feed oiler for a well-known light car has made use of one of the valves to actuate an easily-applied oil-pump.

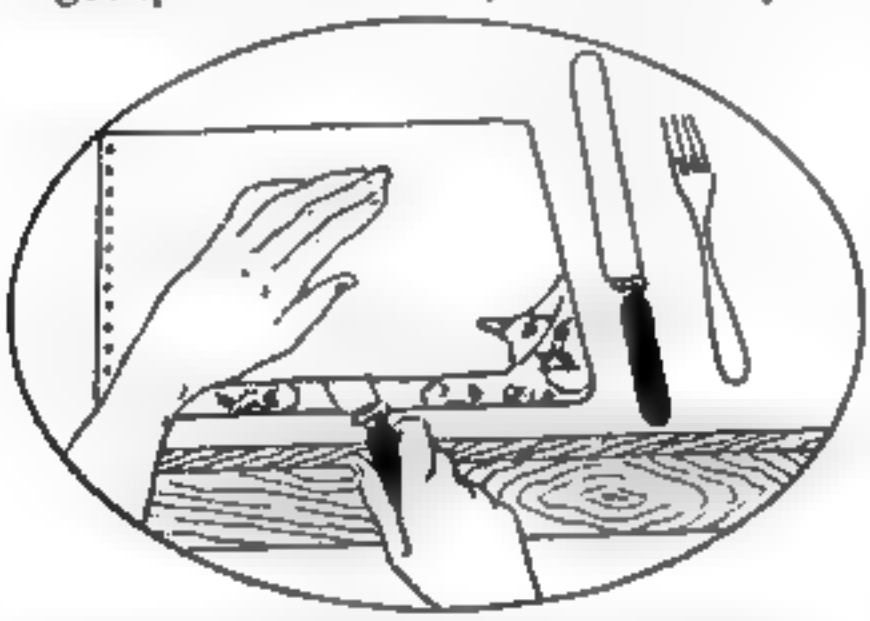
The pump is operated directly from the valve through a rocker-arm which is raised with the valve travel. The rocker-arm is slotted to fit against the valve-stem between the valve-tappet and a special washer, and is pivoted. The upper end is in contact with the end of the pump-piston, and the reciprocation of this piston forces the oil to the engine. The upward movement of the valve-stem causes the rocker-arm to move the pump-piston outward, thus forcing oil out of the little pump chamber. A strong spring forces the piston back on the downward valve-travel to suck oil into the chamber and force it out on the upward stroke of the valve. Two simple ball-valves direct the flow of the oil to and from the pump.

How to Make a Mallet from a Piece of Broomstick

A MALLET can be very easily made by utilizing the remains of an old broomstick. The stick of the broom should be cut off to the length desired (about the size of an ordinary hammer). The head of the mallet is cut from 4 in. square lumber, such as oak or maple, or in fact any hard wood. Drill a 1-in. hole through the head.

Making a Polisher for Table Cutlery from a Piece of Carpet

AN efficient cutlery polisher, as here shown, is easily made from a small board and a piece of carpet. To a board about 6 in. wide, 8 or 10 in. in length and an inch in thickness, with both long edges quarter rounded, is tacked a piece



Powdered brick is sprinkled between the layers and the articles are rubbed over it

of carpet to entirely cover the board on one side and extend over the rounded edges. Over this carpeted board is placed another piece of carpet the same size as the board, but tacked fast only on one end. The nap surfaces of the two pieces of carpet should face each other.

Sprinkle a little cut bath-brick between the layers, moisten knife or fork and rub in and out, as shown in the illustration.—JOHN HOECK.

How to Make Your Watch-Dial Luminous

THE first thing to do is to procure an ounce of calcium sulphide, luminous. The cost since the war is one dollar an ounce, but you can fix perhaps fifty watches with that amount. This element absorbs light, and after being exposed to any bright light for five minutes will glow with a purple light for about four hours.

Remove the crystal from the watch to be treated, and with a pen dipped in shellac go over the numerals and the hands. Some may prefer to make dots only at the numerals. Pour out the calcium on a clean piece of paper, dip your finger in it and press some on the moist shellac. Allow about five minutes for it to dry. The calcium not used may be returned to the bottle.

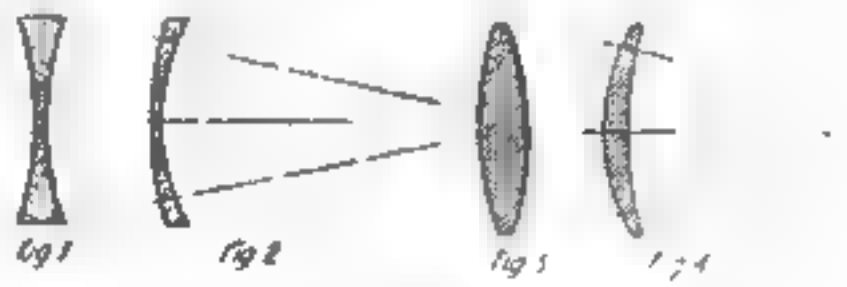
Some Peculiarities of Different Styles of Eye-Glasses

WEARERS of eye-glasses often give offence to persons whom they meet in the street by looking, and apparently staring at them obliquely in a seemingly critical manner.

The offenders are usually near-sighted persons, who wear the old-fashioned biconcave glasses, and who have acquired a habit of looking obliquely at approaching persons, because they are thus enabled to recognize them at a greater distance. This peculiarity does not seem to be generally known. Far-sighted persons, on the contrary, see less distinctly when they look obliquely through their eye-glasses, if these are of the old biconvex form.

The strength of an eye-glass is inversely proportionate to its focal length and is reckoned in units called diopters. A glass of one diopter has a focal length of one meter, a glass of two diopters has a focal length of one-half meter, and so on. As one meter is nearly equal to 40 inches, the focal length in inches, according to which eye-glasses are still occasionally classified, can be obtained by dividing 40 by the dioptric number.

The effective strength of an eye-glass of the old flat form, whether concave (Fig. 1) or convex (Fig. 3) is slightly increased and the distinctness of vision is slightly impaired by looking obliquely



The old flat and convex forms of eye-glasses and the meniscus, or periscopic, glasses

through the peripheral portion. These peculiarities are nearly eliminated in the newer meniscus or periscopic glasses (Figs. 2 and 4). For far-sighted persons the new curved glasses are always to be recommended. Many near-sighted persons, on the contrary, prefer eye-glasses of the old flat type, which give them distinct direct vision of objects at a moderate distance.

Benches for Electrical and Mechanical Machinery

THE benches illustrated are designed to meet requirements where strength and rigidity are essential. A bench is shown in Fig. 1 on which medium weight electrical machinery has been tested for a number of years, without the bench showing any signs of weakening. The top and battens of this bench are made of 3-in. yellow pine, which can be bought dressed to size, at any mill. The top may be tongued or doweled together as shown in Fig. 3, and can be made the length designated, or extended to 12 or 15 ft. by adding another batten and two more pipe-legs. The battens are fastened to the top with ⅜-in. by 5-in. lag-screws; these lag-screws to have washers under their heads. It is necessary to bore the holes in the battens slightly larger than the screws, about ½-in., to allow for the shrinkage and swelling of the top. In boring the top for the screws, use a ¼-in. bit, running the bit into the wood about ½ in. less than the distance the screw will penetrate; also cover the threads of the screw with soap before turning them in.

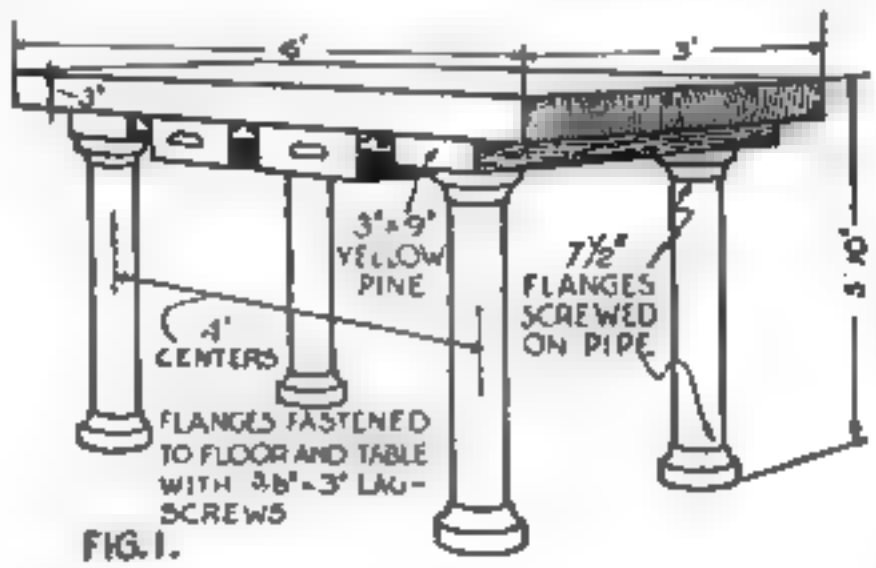


FIG. 1.

A wood-top bench supported by large gas-pipe posts which eliminate vibration

While the pipe used for the legs may seem a trifle heavy, it has been proved by experience that to eliminate vibration it is necessary to use this size. The pipe may be obtained cut to length and threaded on both ends to fit the standard flanges. Screw the flanges on the pipes until the bench is the desired height, and parallel to the floor; then fasten them to the floor and to the battens with ⅜-in. by 3-in. lag-screws.

Drawers will be found very convenient for holding tools and equipment. They may be made of ¾-in. maple, suspended from the bottom of the bench as shown in Fig. 1, which also shows the possible methods of construction. Finish the wood parts with four coats of oil-finish, made by mixing 1 part of boiled linseed oil with 2 parts of turpentine. Apply with a brush and allow it to stand about 3 hours; then rub off with a piece of cloth or cotton waste. Each coat should dry 24 hours before applying the next. A finish of this kind preserves the wood and prevents warping.

Another bench for light machinery is shown in Fig. 2. The frame of this bench is made of 2-in. angle-iron, bolted together with ⅜-in. by 1-in. stove-bolts. The holes for these bolts can be drilled, or if the iron is purchased from a construction company, they may be punched at the works for a small extra cost. The top and shelf are made of 1½-in. oak or maple, screwed fast to the frame with 1¼-in. No. 12 flat head screws. In making the top and shelf, it is advisable to use boards not more than 6 in. wide to prevent warping. The mill will supply this stock, dressed and jointed, ready to be glued together. A clamp, such as shown in Fig. 4, to hold the boards together while gluing, is easy to make

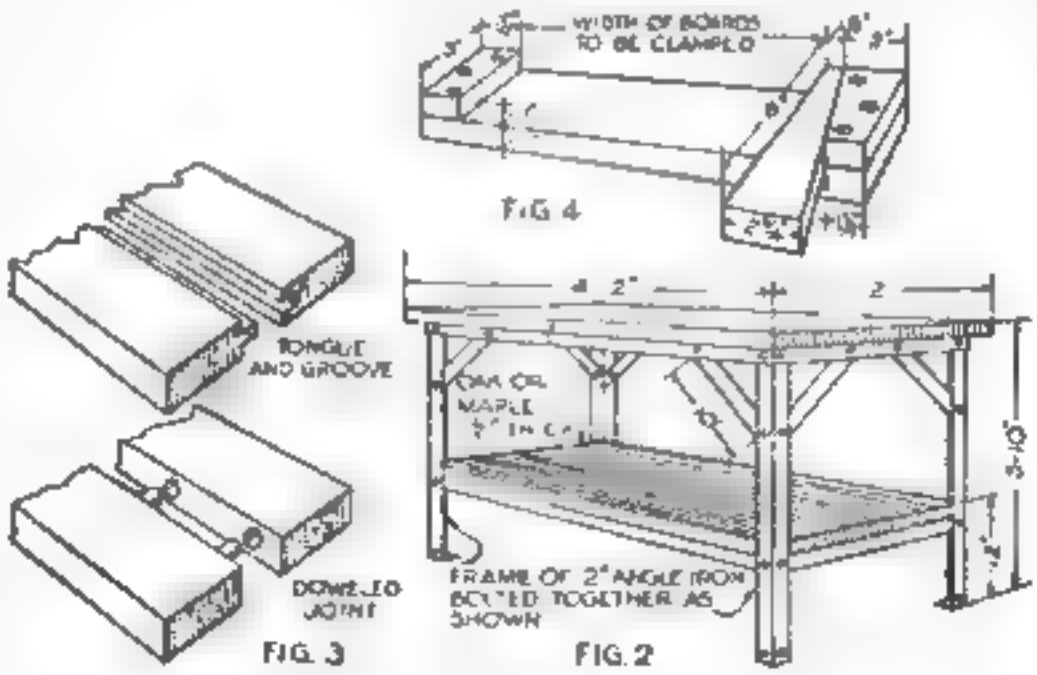
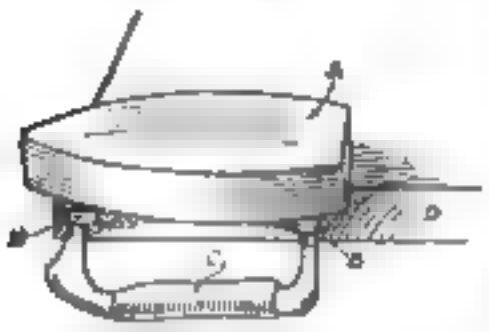


FIG. 4 FIG. 3 FIG. 2

A bench for light machinery. The strength of the joints is increased by doweling them together

Utilizing an Old-Fashioned Flat-iron as an Anvil

A FLAT-IRON of the old cast-iron variety can be made into a useful bench anvil by simply stapling it to the work-bench as shown in the diagram, in which *A* is the body of the iron, *C* the handle, *D* the bench top, and *B*, *B*, staples to hold the handle in position. If a slot is cut in the bench top, fairly heavy work can be done on it.—JAMES MULLEN, JR.

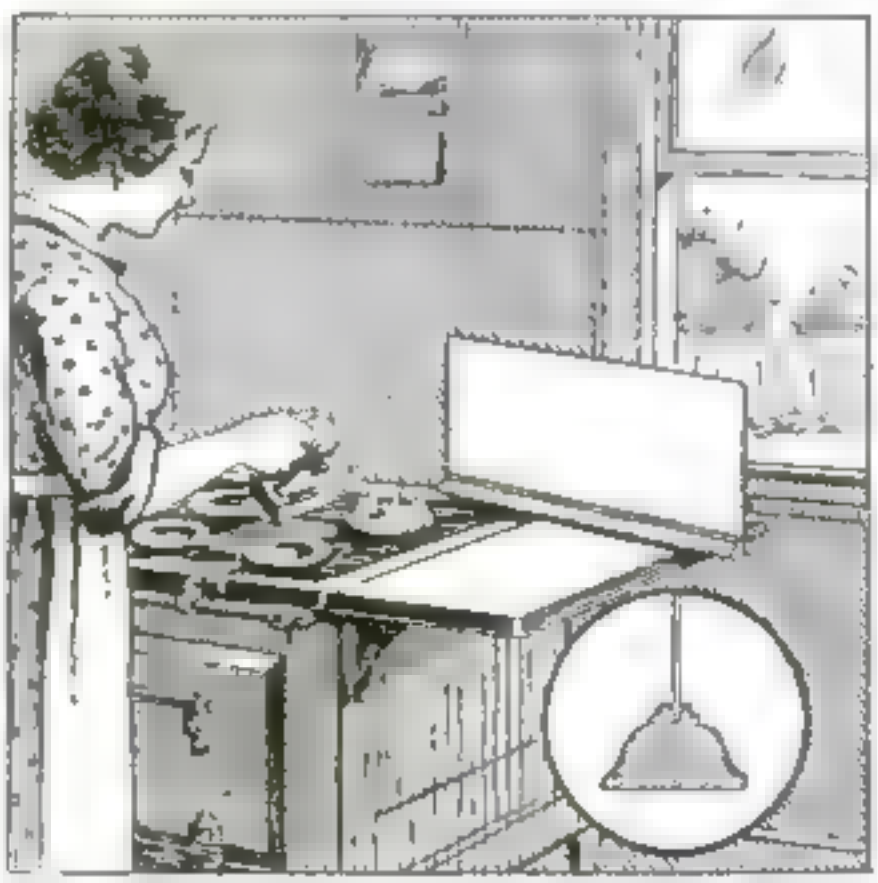


Ordinary flat-iron fastened to the work-bench

Protecting the Gas Range with a Wind-Shield

DURING warm weather the draft from open doors and windows produces a bad effect on the flame of a gas range, sometimes blowing it out. A simple wind-shield may be easily constructed as shown in the illustration. The parts necessary are two pieces of molding, each about 2 ft. long—hardwood being the best material—and a piece of heavy cardboard.

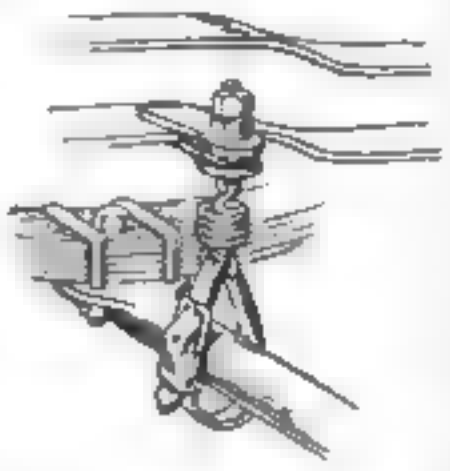
The two pieces of molding are joined together as shown in the sketch at *A* to provide a substantial base. The holding means may be a thin wood strip, or a bit of tin nailed across the ends. In fastening this piece in place be sure to allow enough space between the strips to admit the cardboard. The shield can be shifted to any position desired to protect the flame and will prevent irons cooling from the draft. As it is not stationary it may be made to serve other purposes also.—MRS. JENNIE MCCOY.



The shield may be set in any desired position in order to keep the draught from the flame

Easily Attached Shock-Absorber for the Automobile

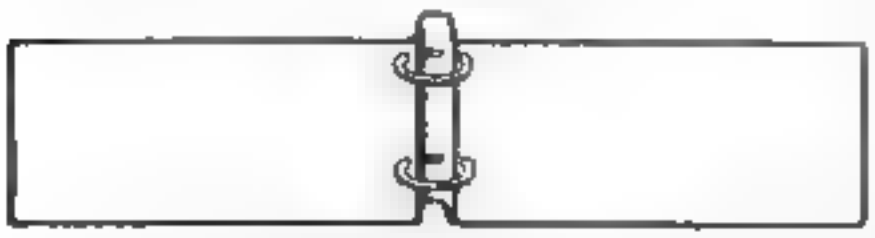
LIGHT cars have a tendency to jounce the passengers uncomfortably unless the springs are checked in their rebound by some shock-absorbing device. Most of the devices on the market require special work on the frame of the car or the springs; some need drilled holes. A new type of rebound check has now been invented which does away with the necessity of drilling holes in the frame, and which can be quickly attached to any type or size of car. The device consists of an adjustable strap attached to a strong, heavy coil spring, which is fitted with a special clamping device, to be attached to the inside of the frame chamber.



A Simple Method of Filing Checks and Receipts

AS a safeguard against duplicating payments and as a matter of a receipt cancelled checks should be kept on file. Unless a special file is provided it is quite difficult to keep them in any kind of order. However, this can be done quite easily with a container made from boards of the ordinary check book cut down to the size desired and the metal back and rings of a narrow loose-leaf notebook. Two small holes are punched in the checks to permit their being placed on the rings. They are then transferred to the container in regular order, and if it is desired to look up a check it can be done without

disarranging the whole bundle. When one of the containers is filled another may be started. Where checks are numbered,



The metal back and rings of a narrow loose-leaf note book used to file checks

mark on the outside cover the number of the first and last check—as 1 to 150.

The Indian's Method of Tethering a Horse

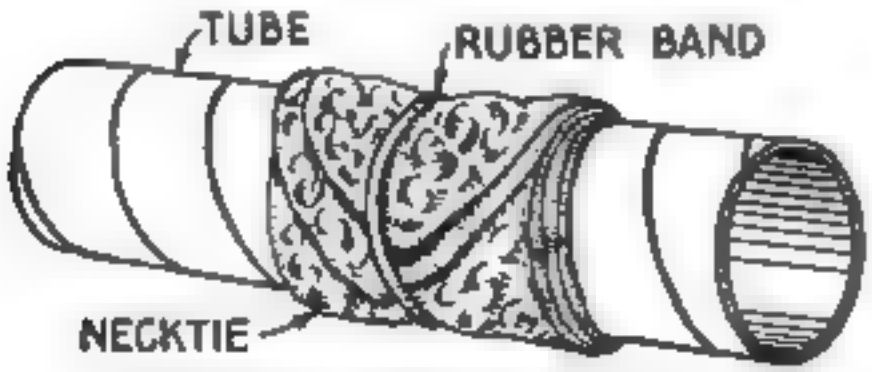
THIS method of tethering a horse may seem impossible at first thought, yet it is quite a simple matter.

A good sized knot is tied in the end of the rope, and a hole dug straight in the ground with a large knife. The hole should be small and quite deep. The knot in the end of the rope is pushed into the hole and the dirt packed down upon it. This makes the horse fast, and to loose him it is only necessary to stand directly over the hole and pull up in a vertical line.

The smartest horse cannot pull the rope from the hole. The only way for him to get loose is to grab the rope with his teeth and pull it out.

Keeping Your Ties in Good Condition

A GOOD "dry method" for taking wrinkles out of neckties is indicated by the drawing herewith. Just wrap the tie tightly around a mailing tube, spreading it out flat while wrapping, and if left in position for a day or so the wrinkles will disappear. A rubber band is most convenient for holding the tie in place, although a string can be used also.



A mailing tube around which several ties may be wrapped to remove wrinkles

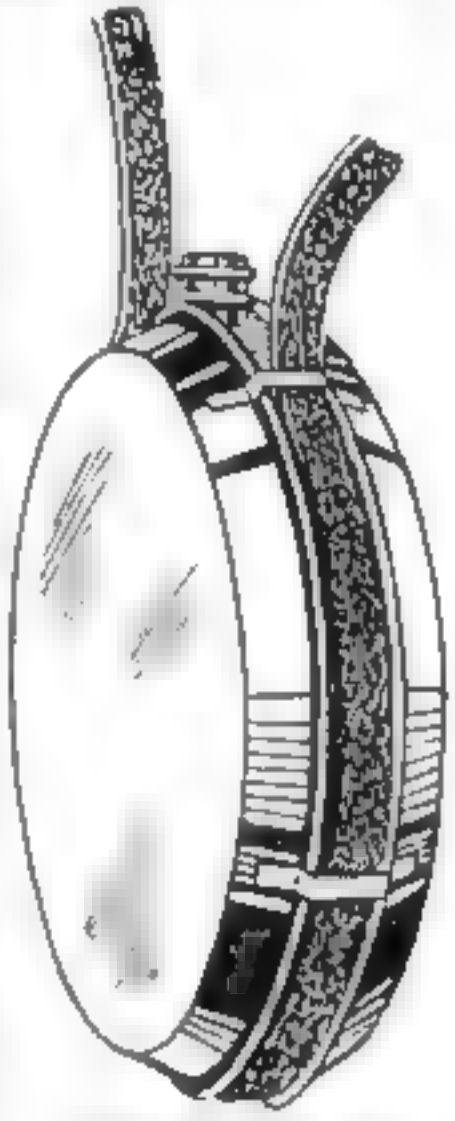
In case of the absence of a mailing tube, use a cylindrical bottle or anything of that shape.

This is much better than hanging the tie and "hoping" that the wrinkles will disappear, for here they are "forced" out.

As for capacity, almost any number can be wrapped on the tube, one outside the other.—N. G. NEAR.

A Canteen Made by a Junior Boy Scout

JUST to be equipped the same as his older brother with camping and traveling utensils, one boy scout made for himself a canteen as shown in the illustration. The parts necessary are two pie pans and a strip of tin, together with a screw-cap like those attached to an oil-can or flask These may be obtained from a tin shop.



A Canteen made from ordinary pie tins

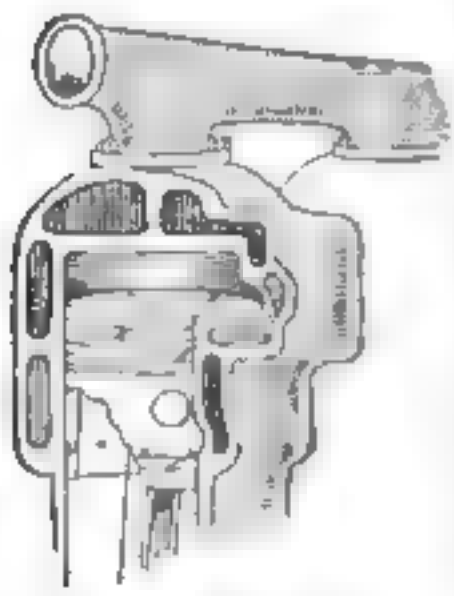
The strip of tin is bent around to fit in between the flat upper surfaces of the pie pans, where it is soldered. The screw-cap is soldered into the strip of tin. Small pieces of tin are soldered on the edge of the canteen at intervals to form loops for a strap to pass around the center tin strip. By this arrangement a means is provided for carrying the canteen in the ordinary manner.

A Simple Way of Making a Canoe Unsinkable

SECURE two ordinary five-gallon tin oil-cans, place one under the thwarts at each end of the canoe and wire them in place. If the canoe is upset it can be turned over and even if filled with water will sustain the weight of two people without sinking.

How to Avoid Excessive Oiling in Automobile Cylinders

WHEN the cylinders of a motor-cycle or automobile show the effect of excessive lubrication, the fault is often in the piston-rings. In order to permit the superfluous oil to run back into the crank-case, the following scheme has been found very effective.



An extra groove in bottom of the piston

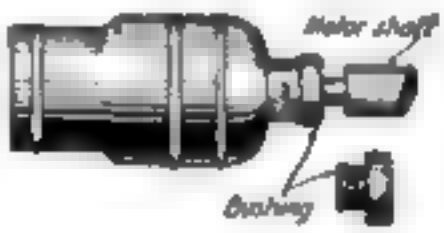
Turn a narrow groove in the lower part of the piston, with the lower edge beveled. Then bore six or seven holes at equal distances around the piston, at an angle through the groove. The sharp edge of the groove scrapes the inside of the cylinder clean, and the excessive oil returns through the drilled holes into the crank-case. It is self-evident that no piston-ring is fitted into this groove.

This method of avoiding excessive oiling will be found particularly efficacious in old-style cars, which have been run for a number of years.

A Novel Experiment with a Lamp-Bulb

A VERY weird and interesting experiment may be performed with a lamp bulb. The materials needed are a motor or other means of rotating the bulb, at fairly high speed, and the incandescent lamp-bulb and its socket. All bulbs will not work in this experiment as the vacuum must be right. Most bulbs that are now manufactured have too high a vacuum, but if the experimenter has an old bulb made several years ago, it will probably work well.

The method of mounting the socket on the motor-shaft is shown in the illustration. The socket is threaded for ⅛-in. gas pipe which is about ⅜ in. in diameter. If the motor-shaft is the same size and is threaded it can be screwed right on. If not, a hard rubber or fibre bushing can be used. The hard rubber bushing which is used with the socket is shown in the detail. This should be screwed into the socket and a hole bored in it below the set screw hole. A screw with the same thread as the set screw and long enough to reach the shaft through the bushing may be used for the set screw. The inside of the bushing can be enlarged with a rat-tail file to fit very tightly on the motor-shaft. The set screw should be turned up tight against the shaft through the bushing.



Mounting the socket on the motor-shaft

The bulb should now be placed in the socket and rotated, the hand being held against it. If the hand is damp it should be allowed to heat up by the friction until it is quite dry. The pressure of the hand need not be great.

If the bulb is right it should light up with a pale violet hue. It appears to work best if the hand is held on one side of the bulb only and does not completely encircle it. Sparks may be observed between the bulb and the hand and also where the filament touches the bulb. It is needless to say that the room should be quite dark.

Prolonging the Usefulness of a Saucepan Cover

WHEN a saucepan cover seems useless because the little knob or handle is lost, push a cork part way through the opening and secure it by driving a nail 1 or 1½ in. long horizontally through the cork on the under side.

The Editor of the POPULAR SCIENCE MONTHLY is always glad to hear from readers who have made simple and useful things for the home and the shop with their own hands and who would like to tell others of their own success. Articles from amateur mechanics, electricians and wireless operators are paid for on acceptance, promptly and liberally. But contributors must understand that only unpublished contributions, offered exclusively to the POPULAR SCIENCE MONTHLY, are desired.

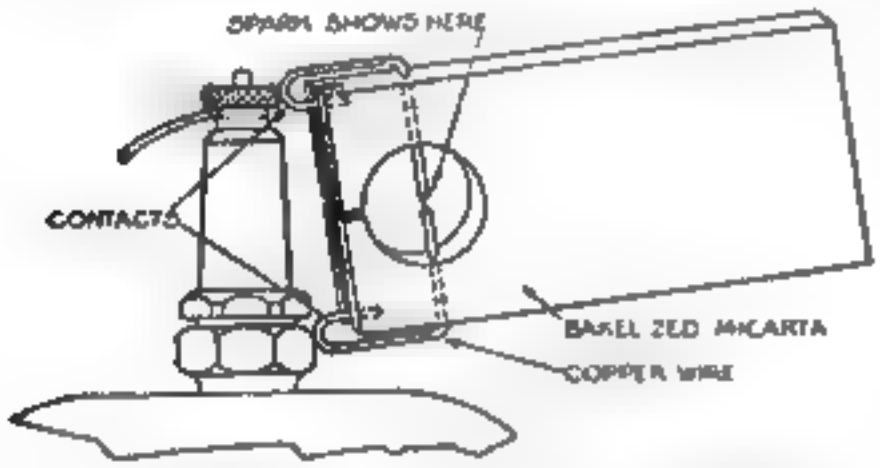
Wireless Communication

The Home Electrician

Practical Electrical Hints

Spark-Plugs Tested Without Removal from Cylinders

THE device shown in the accompanying drawing enables motor spark-plugs to be tested without removing them from the cylinders. It consists of a



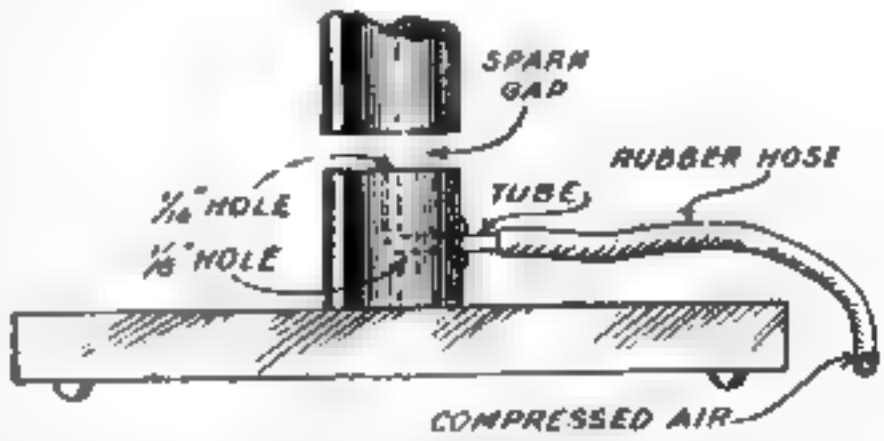
Connecting the parts of a spark-plug so as to test for short circuit

thin slab of non-conducting Bakelized Micarta 3½ in. long, 1½ in. wide and ⅛ in. thick, to one end of which are attached two short pieces of copper wire as shown. The wires are of equal length. One end is bent around with the end in a groove in the Micarta slab. The other is carried along the edge of the slab for a short distance and then bent at right angles and forced down through a hole in the slab to the center of a circular opening cut in the face of the slab as shown. The other wire is bent in the same shape, the ends within the circular opening being about half the thickness of a dime apart.

In operation, one piece of wire contacts the central electrode and the other the shell of the plug. If the spark is in good condition, enough of the current will be shunted through the two wires to cause a spark to jump between the adjacent ends of the wires. No spark will result if the plug is short-circuited and it will then have to be removed for inspection.—JOSEPH BRINKER.

Converting a Plain Zinc-Gap into an Air Blast Spark-Gap

AN interesting suggestion for radio operators is presented herewith. The spark-gap has long been known as one of the most wasteful instruments in the wireless sending set. Many amateurs have been experimenting to reduce its losses. One object of rotary gaps is to prevent arcing because of the ionization of the air in the gap. This disadvantage may be overcome by the use of an air blast gap made from a plain zinc spark-gap. Remove the lower zinc plug and drill a 1/16-in. hole through its center, as shown by the dotted lines in the drawing. Drill another hole ⅛ in. in diameter, on the side, so that it will connect with the first. A brass or copper tube is forced into this second hole on the side, as shown, to make a tight fit. Replace the gap terminal in the stand, so that the tube will project out at the back. The gap is connected in the circuit and a small rubber tube is slipped over the brass tube.



An air blast gap made from a plain zinc spark-gap as a means of reducing waste

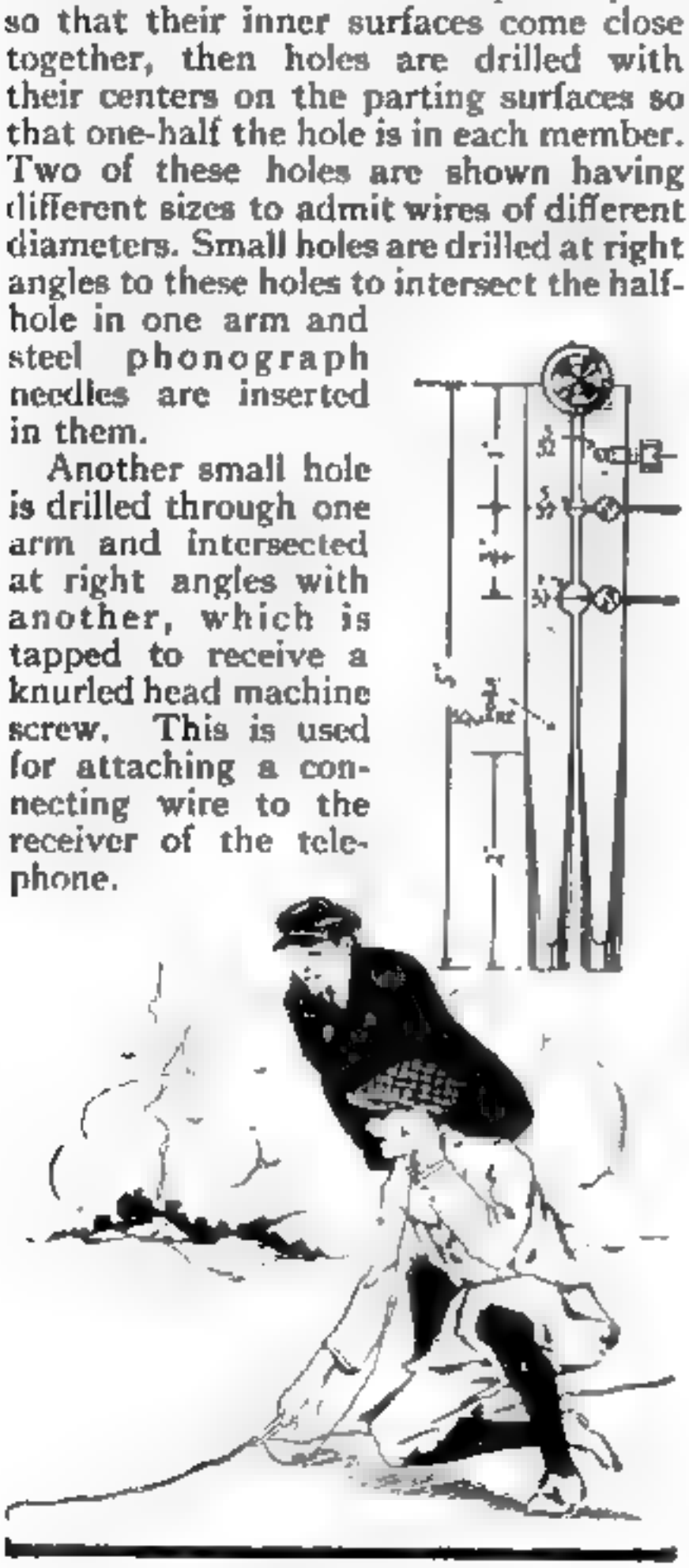
The air may be supplied through this tube by a pair of foot bellows of the kind used by glass-blowers. If a reservoir is added the action becomes similar to that of an organ-blower.

A still better way may be to use a small tank filled with compressed air.

Tapping Field Telephone Wires with a Pocket Connector

THE device illustrated is used in field work for tapping telephone wires where it is necessary to make a call on the line at any point. It is made from the body of the arms that form the ordinary machinist's divider. The sharp, tapering points are cut from a 9-in. tool, leaving square stubs 5 in. long. In the ordinary divider the arms are set apart to allow space for the spring. The arms must be bent to take up the space so that their inner surfaces come close together, then holes are drilled with their centers on the parting surfaces so that one-half the hole is in each member. Two of these holes are shown having different sizes to admit wires of different diameters. Small holes are drilled at right angles to these holes to intersect the half-hole in one arm and steel phonograph needles are inserted in them.

Another small hole is drilled through one arm and intersected at right angles with another, which is tapped to receive a knurled head machine screw. This is used for attaching a connecting wire to the receiver of the telephone.

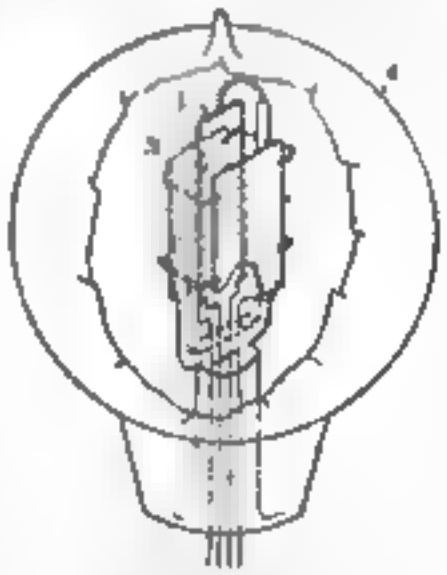


A small pocket device for making connections anywhere on a field telephone line

In ordinary use the connector is held on the wire by hand, but if connections are wanted for any length of time it is best to retain the wing with its nut and screw. In this case the wing should be cut off, allowing only a ¾-in. stub to project. The device is opened wide enough to clear the stub of the wing to admit the wire, then it is closed and the wing-nut set. The needles should not project too far or they will sever the wire.

Strengthening the Static Field of an Amplifier

THE so-called audion principle, especially when used in telephone relays, has been applied to vacuum tubes built in a great variety of ways.



A new type of vacuum tube relay

When the grid, or corresponding electrode through which energy to be amplified is led to the device, is placed close to the filament, the local battery current is usually controlled most efficiently. The closer the grid and the filament are brought together, the stronger will be the static field between them, and the better the amplification. It is necessary, however, to keep the two out of actual electrical contact. If current could flow directly from the grid to the filament the relay would be partially short-circuited and consequently would not work.

U. S. patent 1,169,422, issued in 1916 to A. M. Nicholson, shows the type of vacuum tube relay illustrated. The U-shaped electrode 1 is that through which the incoming feeble currents produce their effects, and takes the place of the grid in the more usual form of tube. The filament 2 is entwined about the U-electrode 1, being wound actually upon it. The two are kept apart by the insulating effects of a thin layer of nickel oxide on the forked conductor. The plates 3, 3 are connected with the local battery, and the whole relay structure is enclosed in the evacuated bulb 4.

Overcoming Troubles in a 200-Meter Wave Outfit

By R. H. G. Mathews

The following article won the second prize of Fifteen Dollars in the POPULAR SCIENCE MONTHLY'S Radio Article Contest. We would call it to the attention of wireless amateurs because it shows how, with a little ingenuity, a wireless amateur can overcome discouraging obstacles. We want more articles of this type.—EDITOR.

WHEN the radio law of 1912 went into effect, many of the amateur operators of the United States dismantled their apparatus and gave up experimentation with wireless telegraphy, thinking that a station which complied with that law could not do successful work. "Successful work" at that time in the amateur field meant transmitting 30 miles, with an input of 2 to 3 Kilowatts. Many amateurs whose stations comply with the present law, are now able to work over distances of from 800 to 1,000 miles with less than one Kilowatt input. To do this long distance work, using a short wave and low power, requires specially designed apparatus. A minimum of condenser with a maximum of inductance must be used in the closed oscillating circuit.

In order to obtain this condition, I designed and built a 43,000-volt, 1-Kilowatt, closed core transformer. Because of the use of this extremely high voltage, a condenser consisting of only 358 sq. in. of conducting surface, on opposite sides of ¼-in. plate glass sheets, is used. With this small condenser capacity, the primary inductance which may be used on a short wave is quite large, and consequently an easy transfer of energy from the closed to the open circuit is obtained.

At first, I made my condenser of the usual packed type, suspended in a tank of oil. I found, however, that my plates were continually puncturing, due, I thought, to my excessive voltage. I eventually discovered that the breakage was caused, not by direct puncturing, but by what appeared to be a crushing of the glass by a force exerted on it by the attraction of the charges of opposite polarity on opposite sides of each glass plate. When the plates were clamped

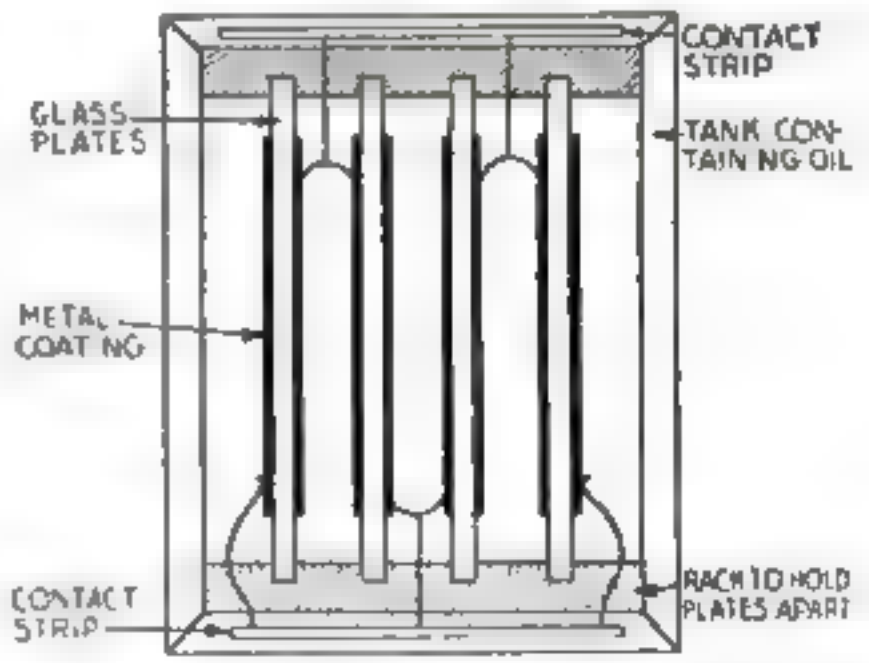


Fig. 1. Method of spacing plate glass sheets to eliminate breakage when immersed in tank of transformer oil

together the crushing strain exerted by this force was tremendous. I entirely eliminated this breakage by spacing

each glass sheet, with its two coatings of metal, ¼ in. from the next sheet, in a small wooden rack, and then immersing the whole in a tank of transformer oil. See Fig. 1.

I was then troubled with a "dragging" spark. Judging from some of the sparks I hear every night, others are troubled in the same way, especially those who are using high voltage transformers. I got rid of this trailing and cut out the ragged sounding spark by making my rotary-gap wheel as shown in Fig. 2. This spark break obtained by the use of this type of wheel entirely eliminated the pulling out of the spark, which had been the cause of my ragged tone.

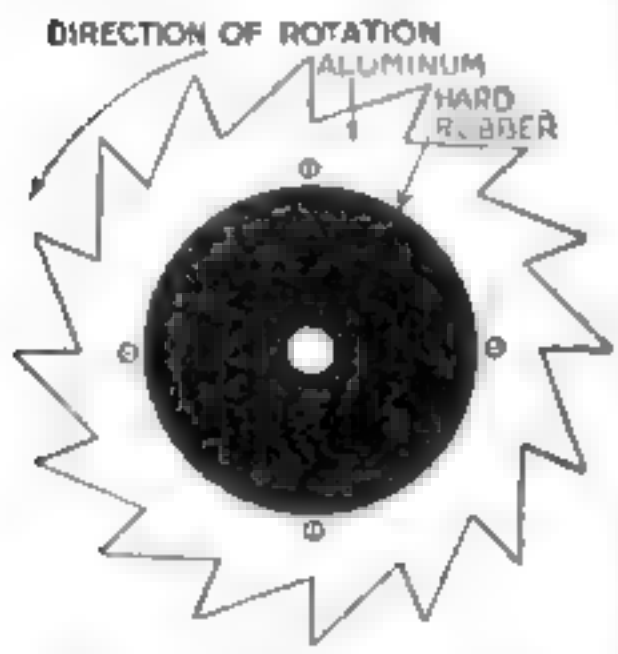


Fig. 2. Type of rotary-gap wheel which eliminated a very ragged sounding spark

Every little while, however, the armature of my motor would burn out on account of an electrostatic kick-back. I tried many kick-back preventers, and many different motors, until I finally tried an induction motor. This type of motor has no revolving coil to be burnt out, and consequently this problem was solved.

I was not yet rid of the troublesome kick-back effects, however, for whenever I sent for any considerable time I would burn out a few secondary sections of my transformer. To stop this annoyance, I made two secondary choke coils, as shown in Fig. 3. Each consisted simply of a single layer of about 50 turns of No. 18 wire wound on a threaded spindle of hard rubber. One coil was connected in series with each secondary lead.

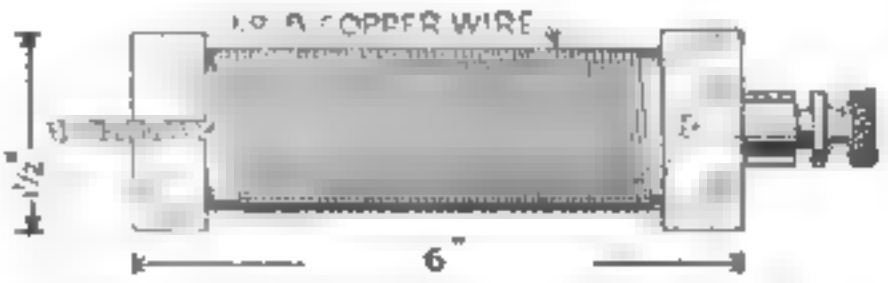
The action of the coils chokes back the dangerous high-frequency surges originating in the condenser, yet allows the low-frequency currents from the transformer to pass through them with ease.

I have found that a low-pitched tone of about 480 sparks per second will carry farther and can be read more easily at a distance than the more common high tone. Other advantages of a low discharge rate are that time is given for the condenser to charge and discharge fully, and also that the points on the revolving wheel do not come opposite the stationary electrodes so rapidly that a back surge from the oscillation-transformer may jump across the gap, and be wasted instead of continuing in the aerial.

The most important thing in doing long distance amateur work is tuning. To get good results, the sending set must be in perfect resonance. The condenser must be of correct size for the spark-frequency used; the primary circuit must be tuned to exactly the wave desired, and the secondary circuit must be put into exact resonance with the primary circuit by the use of a hot-wire ammeter.

To adjust the whole set to resonance, a procedure such as the following should be used. The transformer should be disconnected from the condenser and oscillation-transformer, and a short straight gap connected across its secondary terminals. The aerial should be connected to one side of this gap, and the ground to the other. An arc is then started across the gap and the fundamental wave length of the aerial is determined by a wave-meter. For the best results it should be about 175 meters.

The smallest condenser that will give a clear spark should then be connected in the circuit with the rotary gap and oscillation-transformer primary. By the use of the wave-meter, the number of turns of primary should be adjusted until the wave is 200 meters. The secondary of the oscillation-transformer should then be connected with the



Choke coil consisting of a single layer of about 50 turns of wire wound on a spindle of hard rubber

ground and also with the aerial, in series with a hot-wire ammeter. The secondary should then be adjusted until the maximum radiation is obtained. The aerial and ground should then be disconnected, the condenser increased by one plate and the primary again tuned to 200 meters. The secondary is again connected and adjusted for maximum radiation. This should be continued until the condenser is all in use. A table must be made with spaces for entries of each set of adjustments, and the set finally adjusted according to the combination which gives the highest radiation.

The adjustment marked X would be used, according to the table, since it gives maximum radiation current. In receiving, I have noticed that the chief trouble is interference. The ability to tune out one station and still hear another whose wave is nearly the same as the first, is a coveted ideal, especially since all the amateurs are on one wave, all the commercials on another, etc. A considerable advance in sharp tuning comes with the use of an audion-detector, since with this type of detector the operator must tune sharply if he wishes to hear anything at all. Another useful way of obtaining sharp tuning is by inserting a variable condenser in series with the aerial. By using large inductance in the primary and small series capacity, it is often possible to eliminate much local interference and still hear the desired station readably, although perhaps not as loud as with the straight primary.

If a loose coupler is handled intelligently, and the coupling between its coils is adjusted carefully, it will get rid of a lot of interference. A small condenser placed in shunt with the loose coupler secondary is always of assistance on the longer waves, such as those from 600 or 1,000 meters up. A sample table is shown in Fig. 4.

Many amateurs pay too little attention to their ground connection. It is fully as important as the aerial. A ground which I have been using for over a year with the best of results is made of a $^{1}/_{16}$-in. sheet of copper, 4 by 6 ft., buried 10 ft. underground. Connection is made to this sheet by a No. 4 bare copper wire. This size wire is required by the Fire Underwriters, for both lead-in and ground-lead, and besides satisfying their requirements, it is a help towards good transmitting results on account of its high conductivity.

Many of the aerials seen as one goes through the city are not constructed with any idea of what their wavelength will be, or of which type of aerial is best

Fig. 4. TUNING CHART

Wave Length	Power	Condenser	Primary Turns	Secondary Turns	Radiation
200 M	1 K W	4–Sheets	6	14	½ Amps.
"	"	5– "	5½	13	1
"	"	6– "	5	12	1
"	"	7– "	4½	11	2
"	"	8– "	4	10	3
"	"	9– "	3½	9	5
"	"	10– "	3	8	6 X
"	"	11– "	2½	7	5
"	"	12– "	2	6	4

for the work desired, etc. For 200-meter work, the "T" type aerial is probably the best. It can be made almost double the length of an "L" aerial having the same wavelength, thus giving increased aerial capacity. A three-wire "T" type aerial 100 ft. long, not too high, has a fundamental wavelength which will be about right when used with sufficient oscillation-transformer secondary to bring the emitted wave up to 200 meters. Enough secondary may be used to insure good transference from the closed to the open circuits with an aerial of this kind. The wires should be spaced 3 or 4 ft. apart.

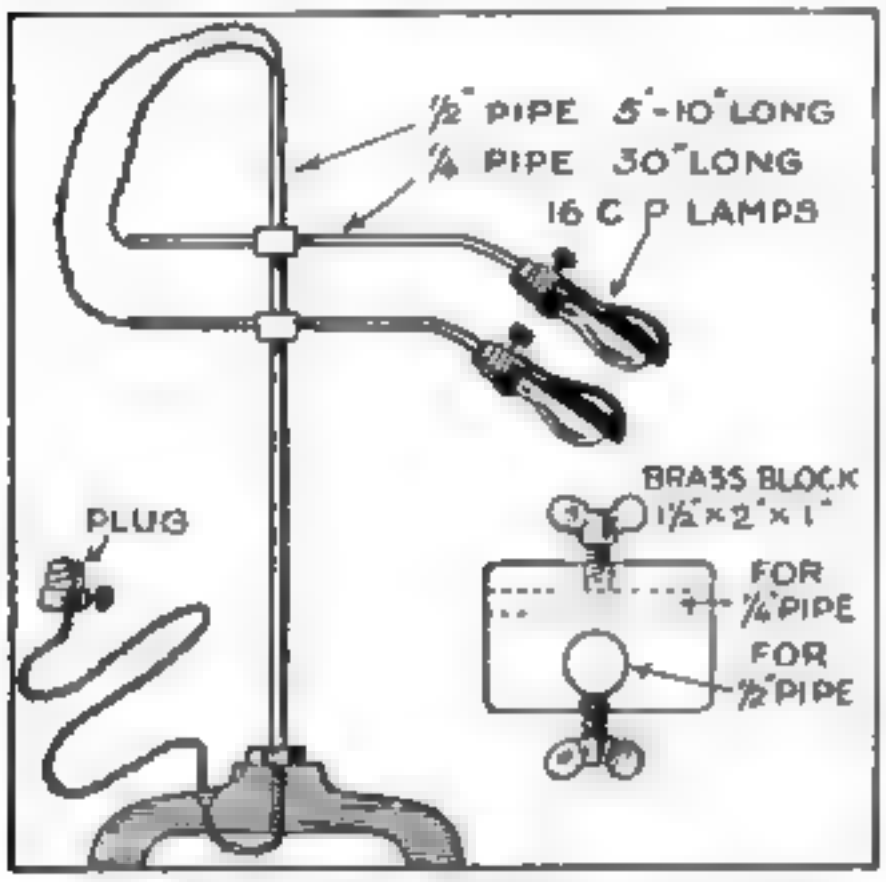
If an amateur's wireless set is given careful study in its design and careful work in its tuning and adjustment, there is no reason why, with operators of ½ by 1 K.W. input it should not do the long distance work that is being achieved by the few operators who have given their outfits careful study.

Removing Old Putty from a Window-Pane with a Hot Iron

A HOT soldering or other iron run over old putty will soften it so that its removal can be easily accomplished with a knife or chisel. Care should be exercised that the glass is not heated enough to cause it to crack.

More Light on the Occupant of the Dentist's Chair

AN ADJUSTABLE lamp for dentists' use will doubtless be appreciated by the profession. In the one described the base, which is 18 inches in diameter, is turned from wood to match the office furniture. If not convenient to turn it, it can be made of two crossed arms, making a base with four feet. A half-inch pipe, 5 ft. 10 inches long, is fastened to the base by passing it through a hole



A dentist's light adjustable at any angle which furnishes light from two directions

in the center. A long screw, lock-nut and bottom nut and washer make it secure.

Two blocks are drilled so as to slide on this pipe, and thumb screws are topped to bear on the pipe. This permits adjustment at any height. Each block is drilled at right angles for the ¼-in. pipe arms, and is also furnished with a thumb screw. This makes movement in any direction possible. The arms are 30 in. long, and bent to an angle of 30 deg. about 4 in. from the end, which is threaded for an ordinary 16 C.P. lamp socket. The openings through base and the ends of the pipes are fitted with fibre bushings. The apparatus is wired as shown and fitted with screw plug for wall outlet.

This lamp, properly adjusted, will furnish light at any angle and from two directions at once, the advantage of which is apparent.—H. S. RUCKER.

A Tool for Fishing Wires Through Small Openings

ORDINARY cork screws or screws made from a steel rod in a similar shape will make a very handy tool for

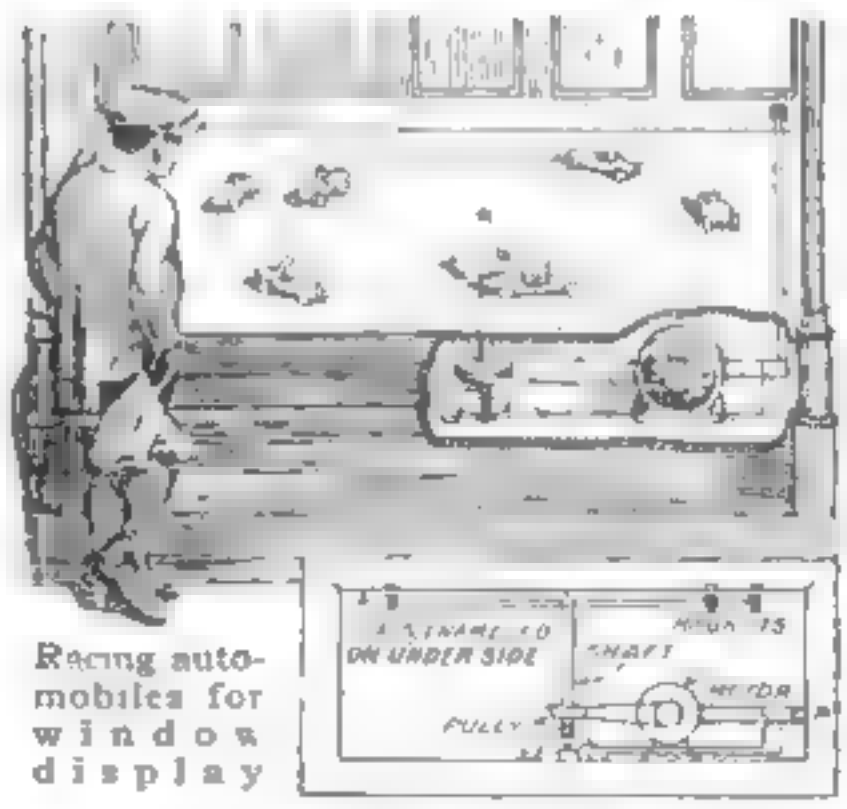
A tool with screw for pulling wires through small holes in insulation or walls

the electrician in pulling wires through small holes in insulation, walls, etc. In making a special tool, twist one end in cork-screw fashion so that its center will fit over the regulation size, No. 14 gage, rubber-covered wire.

The screw-end is inserted in the hole and turned around to make it take hold of the wire. The wire-end can be easily drawn through the opening. Holding the tool in a slanting position makes it take hold of the object to be removed quickly. The length of the tool will depend on the user and the kind of work.

Magnet-Power of Toy Automobiles for Window Display

WHEN plug *P* is inserted it furnishes current for the motor, which in turn revolves the shaft and also the



Racing automobiles for window display

magnets. The same current energizes the magnets. The little automobiles are made of soft iron and when the shaft revolves, taking the magnets with it, the cars follow in the magnetic field. Gears of any size can be applied so the magnets can revolve at different speeds, and even in opposite directions.—H. B. PEARSON.

How to Become a Wireless Operator

II.—Construction of a One-Mile Wireless Transmitter

By T. M. Lewis

(*Continued from September issue*)

IN AN article published last month, directions were given for putting together a little buzzer wireless telegraph set which would operate over a distance of a few hundred feet or even more. This small outfit was sufficient to demonstrate such of the principles of wireless telegraphy as should be known by every student and to send messages from one house to another nearby. The receiver was sensitive enough to pick up messages from commercial stations for some distance around, provided that a fairly long antenna wire was connected to it and properly tuned.

The amateur who has built and tested the buzzer set will want next to own and operate an outfit with which he can signal over greater distances. It is the purpose of this article to describe the construction of a wireless telegraph sender which can be made cheaply and easily, and which will give good strong signals at a suitable receiving station located as much as a mile or more away. The apparatus for the receiver will be taken up in later articles; the experimenter may well spend the intervening time in building his sender.

Transmitting Coil

One of the first requisites in increasing the distance over which messages can be sent is to increase the effective power of the sender. The buzzer run from a couple of dry cells is not strong enough to make waves which will carry very far, so it becomes necessary to get an instrument which will do better. Such an apparatus is the ordinary induction or spark-coil. The amateur may build his own spark-coil by following the descriptions which are given in a great many books on experimental electricity, but in the long run he will find it cheaper and more satisfactory to buy one. An automobile jump-spark coil is about as good a small induction coil as can be obtained. Often it is possible to get one at a nominal price from a garage or an electrician in the neighborhood. Even if purchased new from an electrical supply house, a good coil capable of giving a 1-in. spark between needle points in air will not cost more than three or four dollars.

There is also needed a Morse key, for sending the dots and dashes which make up the signal letters. This may be an ordinary telegraph key, which costs about seventy-five cents, or even a "strap" or signal key of the kind that sells for only twenty-five or thirty cents. If he desires, the experimenter may build his own key as shown in last month's article. For the heavier currents used in the spark-coil (as compared to the buzzer) it is a good plan to use larger key-contacts than those illustrated. They may be made by soldering copper washers on each of the contact screws.

To furnish power for the coil, the best thing is a 6 or 8-volt storage-battery.

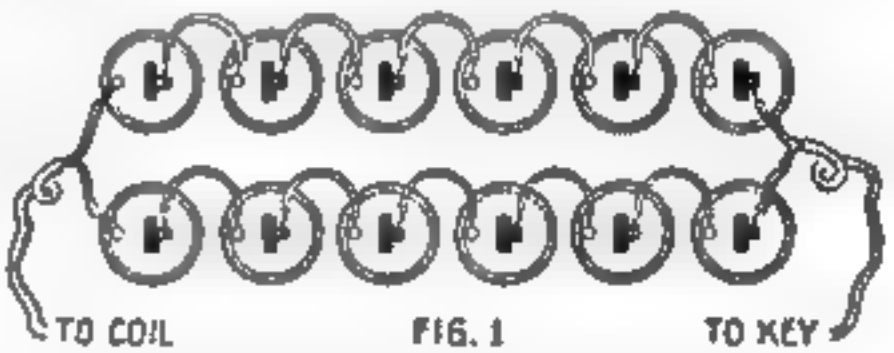


FIG. 1

Twelve dry cells arranged so as to distribute the load between the two sets

This is quite expensive, however, and also requires occasional recharging. Satisfactory results may be secured by using 12 dry cells connected as shown in Fig. 1. With the battery arranged in this way the voltage is no greater than can be had from 6 cells, but the load is distributed between two sets of cells working side by side in parallel. As a result, the battery will last much longer than if only 6 cells were used. The vibrator on the spark-coil should be adjusted so that it buzzes freely, with a high-pitched sound, whenever the sending key is pressed. A spark-gap connected

across the secondary winding will break down whenever the vibrator is started buzzing, and a singing, clear spark will jump across as long as the key is held down.

The Spark-Gap

A good spark-gap for the wireless sender can be made as shown in Fig. 2. Two battery zincs, Z, Z^1, which can be bought from any electrician, are cut off to about 3 in. in length, leaving the connection screws at the head of each.

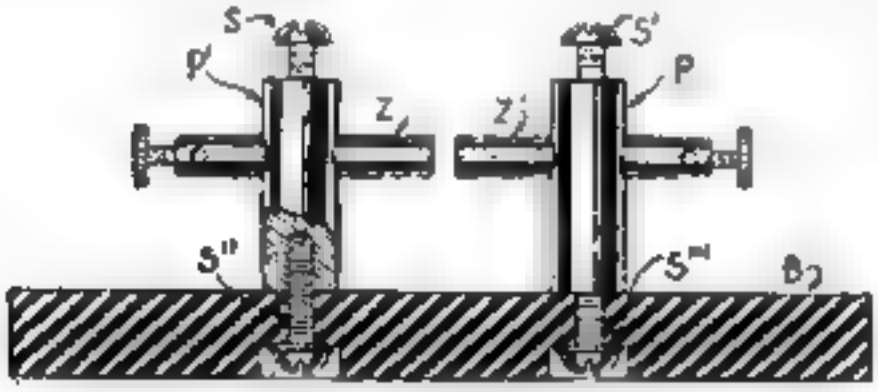


FIG 2

A spark gap made from two battery zincs and a hardwood base boiled in paraffin

Holes to fit these a trifle loosely are bored through two stubby brass standards or pillars, P, P^1. A smaller hole is bored lengthwise through each pillar and tapped to take a 10–24 machine screw, such as S and S^1, to clamp the zinc electrodes in any position desired. Similar screws, S^2 and S^3, pass upward through counter-bored holes in a hard rubber base, B, and serve to fasten the pillars in place. Hardwood boiled in paraffin may be used for the base, but rubber is better because it is a better insulator. The ends of the zinc rods, where they come close together, should be filed perfectly smooth and parallel.

The Loading Coil

It is essential to use a "loading coil" with this outfit in order to get the best results, and to make the transmitter meet the requirements of the Federal laws governing the operation of wireless telegraph senders. This coil can easily be made by following the suggestions given in Figs. 3 and 4. Two square boards, about 12 by 12 in. with rounded corners, are first cut out of hardwood about 1 in. thick. A hole ¼ in. in diameter is drilled at the center of each, and counter-bored to about 1 in. in diameter in the bottom of the baseboard at C. Four ½-in. holes are then bored in each, at points a little less than 2 in. from the corners, along diagonals as shown in Fig. 4. Twelve porcelain insulators of the sort shown in Fig. 5 are slipped over each of four ½-in. hardwood dowels, whose ends pass through the ½-in. holes just referred to and are cut off flush with the upper and lower surfaces of the top and base. A long ¼-in. brass bolt is passed upward through the central holes, so that its head drops into the counter-bored space in the base and its threads project a short distance above the top. A washer and nut put on the upper end will then hold the entire framework together.

Some No. 10 bare copper wire, or some stranded bronze tiller-rope or aerial wire, is to be wound spirally on the insulators. Referring to Fig. 3, the end is first wrapped around the upper front right-hand insulator A and spliced on itself. The wire is then led straight back to the top insulator of the back right upright, then across to the top back left insulator, as shown by the dotted line, then forward to the top front left insulator, and then to the next lower front right porcelain. The winding is continued as shown until the last insulator, B, is reached; there the wire is made fast by splicing, as before.

Two connected clips must be made or purchased. The spring testing clips sold by electrical supply houses are admirable for this, though anything of the sort will

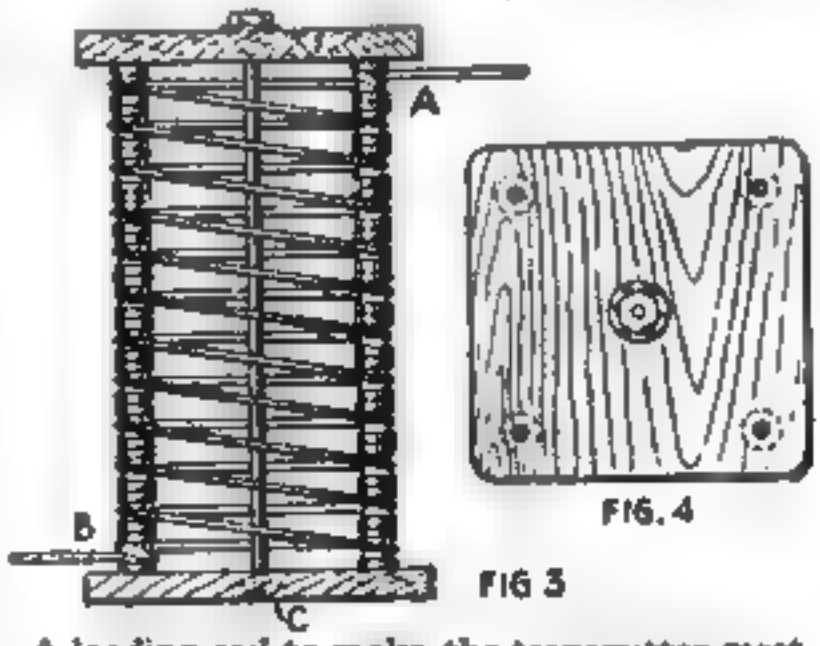


FIG 3

FIG. 4

A loading coil to make the transmitter meet the requirements of the federal laws

do. Flexible wires are soldered to each of them, so that connection to any part of the bare wire-spiral may be made merely by clipping on the desired point.

The Aerial

The laws permit amateur wireless stations to use any wavelength up to 200 meters, provided that the wave sent out is sharp and pure. This means that the aerial wire system to be used with the sending apparatus described must not be more than 75 ft. long, measured along the conductor from its top to the ground connection. It is a good plan to use two wires about 50 ft. long running side by side to the top of a tree or chimney or specially built pole, keeping the wires about five feet apart by fastening them at each end to a light wooden spreader. The top, and in fact the whole aerial, must be thoroughly insulated, if good results are to be secured. An excellent plan for preventing electrical leakage is to connect in series, with loops or rope, five or six porcelain insulators of the kind used in building the loading coil (Fig. 6). These are inserted between the spreader which carries the antenna wires and the rope halyard which is used to haul up the aerial. Similar strings of insulators must be used to guy out the bottom of the aerial. Where the lead-wire enters the house and connects to the instruments it should pass through a thick porcelain tube, as shown in Fig. 7.

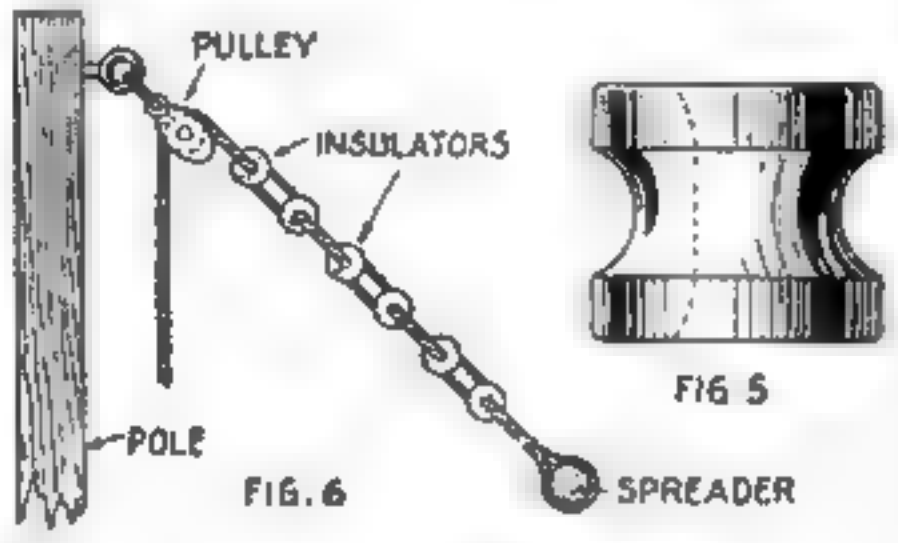


FIG. 6

FIG 5

Fig. 5. Type of porcelain insulators
Fig. 6. The insulators connected in series

The ground connection may be made by wrapping several turns of bare copper wire tightly around a scraped water or steam-pipe. The connection should be made at a point near to the sending instruments.

If no water pipes are available, a large copper or iron plate may be buried deeply in moist earth. As a rule, though, such earth connections are not as satisfactory as a pipe forming part of the town water system.

Connecting the Set

The several instruments making up the complete sending set must be connected up as shown in Fig. 7. The spark-gap should be adjusted with its electrodes quite close together —never more than 1/8 in. apart and at least half of the loading coil is to be put in series with the antenna. Unless a large part of this coil is used the transmitter will not radiate pure, sharp waves, and its use will violate the law and make its operator liable to prosecution by the government. If the spark-gap is kept short and a considerable portion of the loading coil used, there will be nothing to fear so long as neither of the aerial wires is over 75 ft. in length.

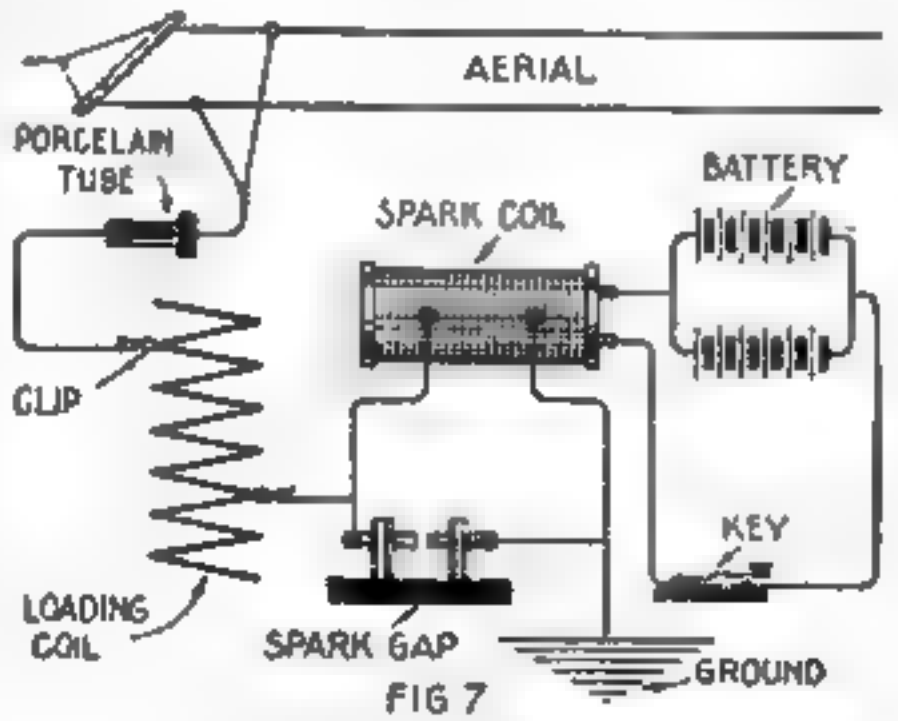


FIG 7

Manner of connecting the several instruments making up the complete sending set

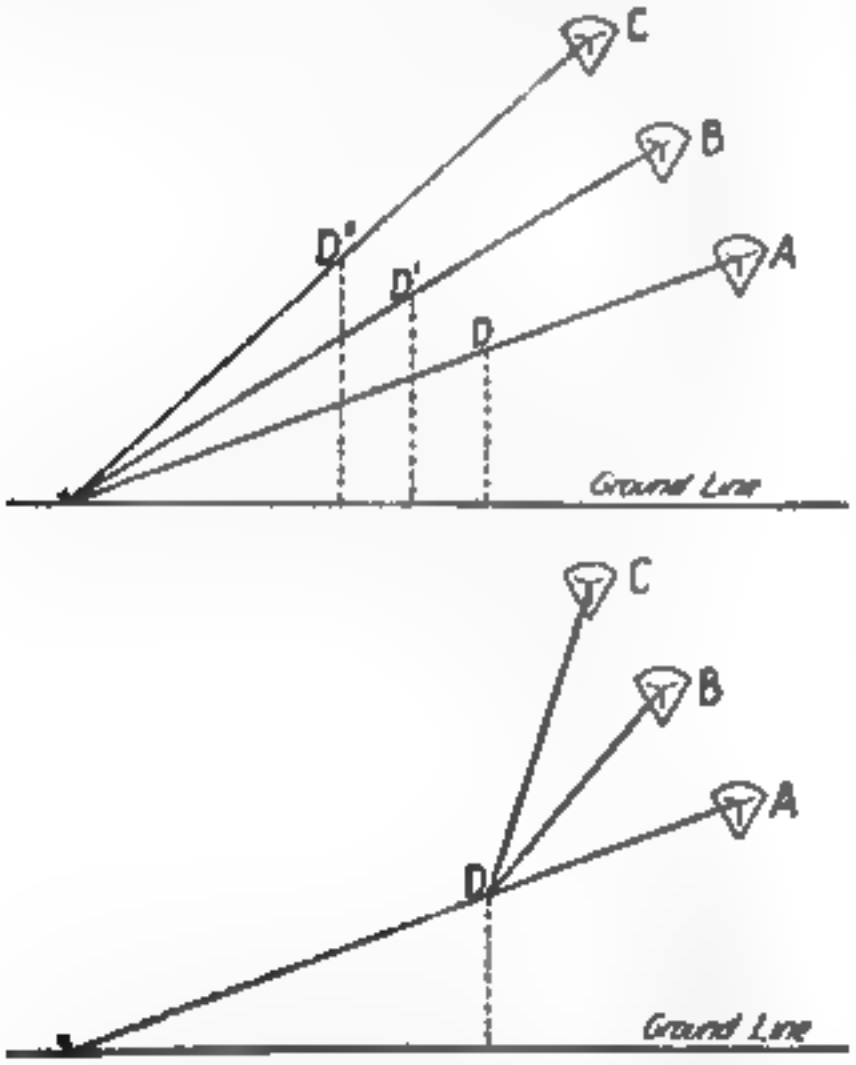
Whenever the key is pressed, if the set is properly connected and adjusted, a bright, snappy, singing spark will jump across the gap. Each spark starts a train of high frequency currents oscillating back and forth in the aerial wires, and a train of electromagnetic waves is radiated into space. A suitable wireless receiver located where a portion of these radiated waves will reach it, will pick up some of their energy and produce from it a sound which indicates the dot-and-dash buzzes of a Morse signal.

(*To be continued*)

Employing Kites to Support an Aerial

A DOZEN years ago there occurred to Army officers the idea of sending up a wireless aerial to a great height by means of kites, in order to increase the sending and receiving range of a field radio set. A few experiments were made, but without great success. In 1908 further attempts were made in this line, but again without especially encouraging results.

After the German steamship, Prinz Eitel Friedrich, had been interned at Norfolk, Va., last spring, a story leaked out as to how her captain (Herr Thierich-



Manner of keeping aloft aerials with a string of kites on a line of unvarying length

sen) kept posted as to the whereabouts of enemy ships, and was thus able to avoid them for many months. He adopted the simple expedient of sending aloft an aerial supported by a string of kites. Such excellent results were obtained that a paper containing wireless news of the war was printed daily on board ship

Recalling this use of kites by the German ship, Adjutant General Cole, of the Massachusetts Volunteer Militia, decided to resume experiments with a kite-supported aerial. Consequently he invited Samuel F. Perkins, of Boston, make some further tests at the July maneuvers of the Militia in northeastern Massachusetts. Late one afternoon, at Newbury, Mr. Perkins sent up four of his huge hexagon kites. The aerial was attached to the kite line about half way between the kites and the earth, and hung vertically a distance of about 600 ft. to the ground. The lower end was attached to an ordinary ¼-k. w. field radio set, such as is used ordinarily with a 25 or 30-ft aerial. The swaying up and down of the kites caused the end of the aerial to be jerked off the earth or to coil up upon it, and consequently the operator was unable to tune, because of the constantly varying length of the aerial. He explained to Mr. Perkins that this was the cause of failure in many earlier kite experiments. With Yankee ingenuity Mr. Perkins soon put an end to the varying in length of the wire, and from that moment almost startling results were obtained.

The method by which the aerial was kept at an unvarying length is illustrated in the diagram, where *A*, *B* and *C* represent the kite line in three different positions corresponding to the verticals *D*, D_1, and D_2. A shows the lowest and C the highest positions of the constantly swaying kites. By securing the vertical aerial wire to the ground when the kite line has reached its lowest angle, any further rise of the line occurs from the point *D* at the top of the aerial instead of from the point where the kite line is secured to the ground. Consequently, the point *D* always remains at a given height and the length of the aerial is always the same. It was this simple idea of holding down the kite line by means of the aerial itself that made the difference between success and failure, and made it possible to increase the range of an ordinary ¼-k. w. wireless set so greatly that it became in many ways the equal of a big tractor-set worth thousands of dollars.

As soon as the aerial was kept at an unvarying length in the experiment mentioned above, messages were received from the Filene Station at Boston, from the Battleship Georgia off Newport, from Arlington, Va., and even from as far away as Bermuda, a distance of over a thousand miles.

Lieutenant H. C. Gawler, the chief radio inspector of the New England District, and Inspector Cheetham, the Marconi expert, were even more surprised when they began sending from their improvised station, for the replies they received showed that they were able to send a distance of 150 miles, or six times as far as would have ordinarily been the case. The normal record for a government field set is 44 miles, but it is probable that an ordinary field outfit can be made to send to a distance of 300 miles or more, when a kite-supported aerial is employed and if all conditions are favorable. It is possible to send up the kites and the aerial when there is very little breeze.

In last summer's Plattsburgh maneuvers the signal corps were shown that they could increase the range of their field set by about 200 miles if kite aerials were used, and also that they could do this almost any day. When it is impossible to send up kites, it is proposed to use a small hydrogen balloon. A later test of the improved pack set at Fort Leavenworth demonstrated that it is now possible to send even farther than was believed possible.—STANLEY Y. BEACH.

A New Spark-Gap for Wireless Telephony

IN order to transmit speech by wireless it is necessary to produce continuous waves, or, as a substitute, groups of electromagnetic waves at a very high

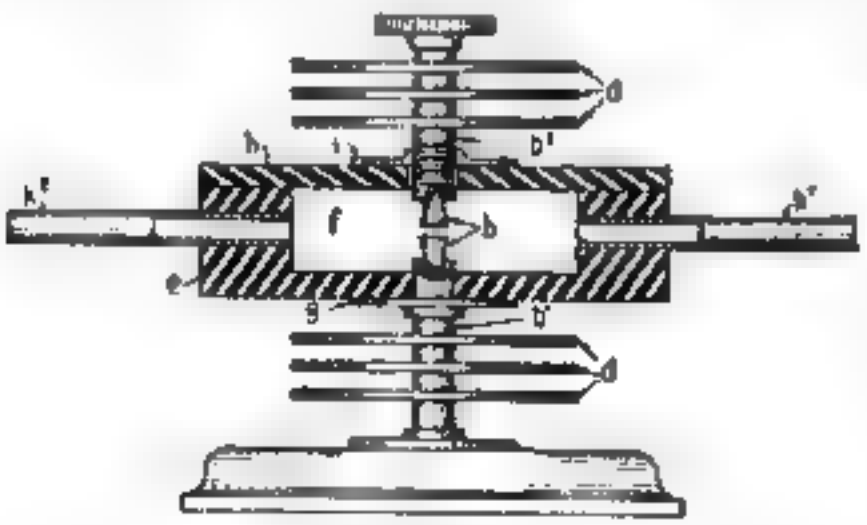


FIG. 1

A special gap with highly cooled sparking surfaces inclosed in a gas-filled chamber

frequency. The transmitter should be uniform in operation, so that a practically continuous stream of radiant energy will flow out from the sending antenna. The various forms of arc generators, when very carefully adjusted, or now familiar high-frequency alternators, can be used in this way. It has been suggested by various inventors that sparks occurring at very high frequencies might

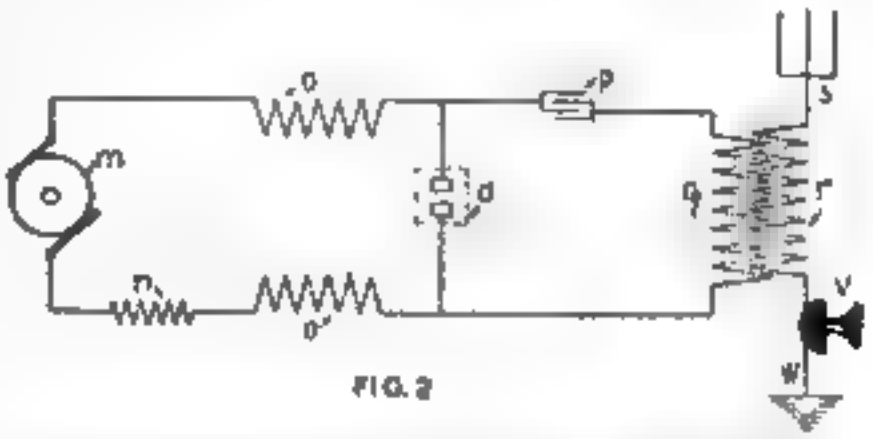


FIG. 2

A diagram showing how the telephonic sparker may be interposed in the line

also form a basis for radio-telephonic power generation; many forms of quenched and rotary-gaps for this purpose have been proposed.

In U. S. Patent 1,173,562 there is shown a special gap having small highly-cooled sparkling surfaces enclosed in a chamber through which passes carbon dioxide gas. The inventor, W. T. Ditcham, points out that if large electrodes are used the spark will not remain sufficiently constant for the transmitted speech to be clearly articulate. In his new gap, which is shown in Fig. 1, the spark is restricted to the ends of the small plugs *B*, which are firmly set in the shafts B^1 and B^2. These rods carry cooling flanges *D*, and are secured to the walls *H* of the gap chamber *F* by the flanges *G*, *I*. Fresh carbonic acid gas is fed through the tubes K^1, K^2 and serves to cool the gaps.

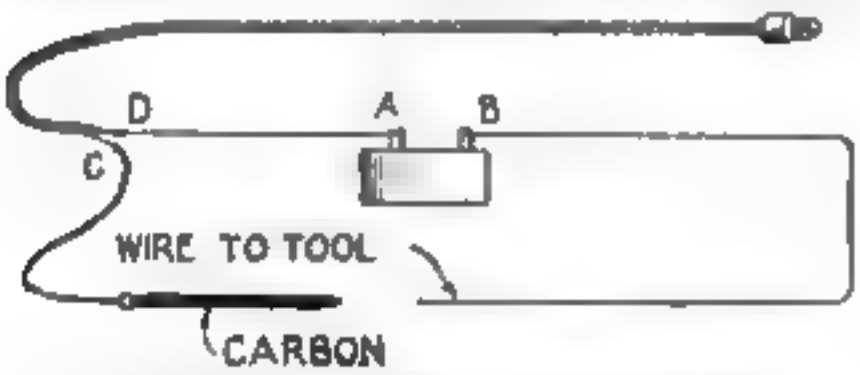
Figure 2 shows one of the circuits in which the new discharger may be used. *M* represents a direct-current generator, of about 1,000 volts, which is connected through resistance *N* and choke-coils *O*, *O*, to the terminals of the gap *A*. The high-frequency circuit is composed of the gap, the condenser *P* and the primary *Q*; to this last-named coil is closely coupled the secondary *R*, which, with the microphone *V*, is connected between the antenna *S* and ground *W*. The two oscillation-circuits are not tuned to the same frequency as if measured separately, for the best transfer of

energy from primary to secondary is secured with couplings as high as 40 per cent; this close linkage requires an apparent detuning for the best results. It is preferred to have the resonant frequency of the aerial circuit somewhat higher than that of the highly-damped primary.

Several other ways of relating the two circuits and the microphone are shown in the patent. In one of these the telephone transmitter is placed in an intermediate coupling-loop which contains no condenser and is therefore a periodic. Other minor variations are possible. The power leads may be connected across the condenser *P* instead of across the spark-gap, or several spark-gaps may be used in series. In operation the voltage and gap-length are adjusted so that sparks are produced at a very rapid rate; each spark creates a rapidly damped train of oscillations in the primary, and the energy of these is transferred to the secondary, where the result is a series of feebly damped and practically constant-amplitude high-frequency currents. The strength of these antenna currents is altered by the resistance changes in the microphone, and speech-waves are thus radiated.

Tracing Initials on Tools with Electricity

TOOLS may be marked very easily with electricity, which is easier than marking with acid. Screw the plug of an old cord into a socket, and wrap wire *D* around point *A*. Connect another wire with *B*, which is connected with the tool to be marked. The other

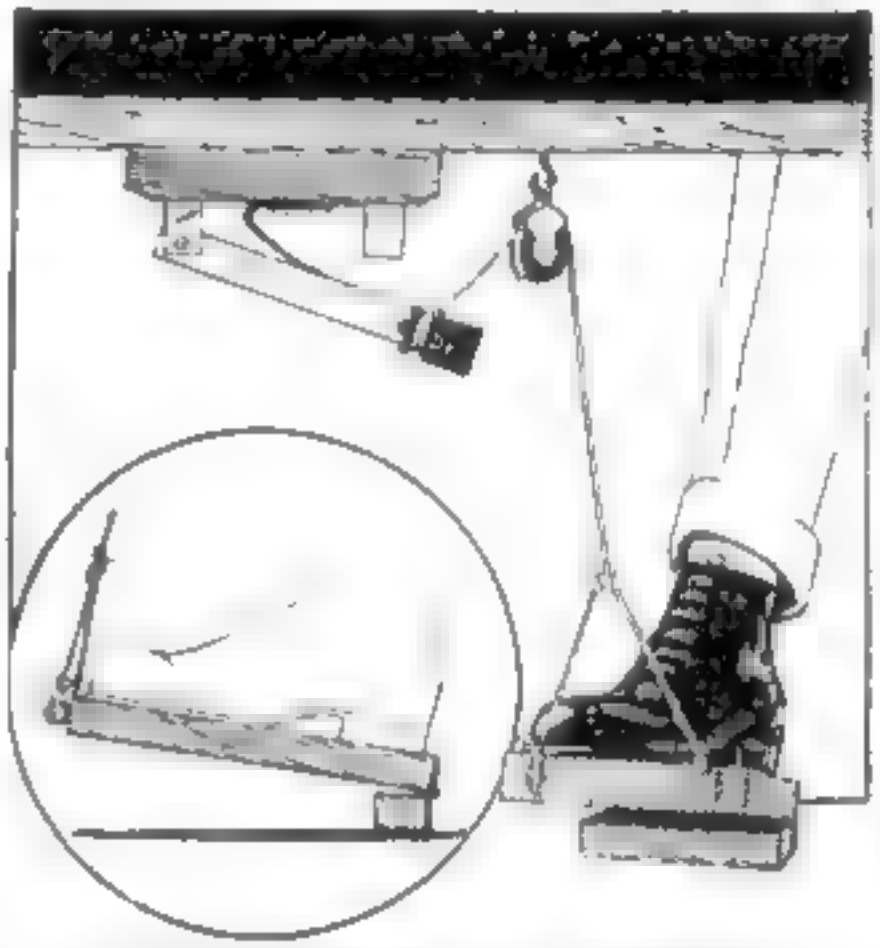


Connections to a rheostat and carbon for writing letters on steel

strand of wire *C* is connected with the graphite from a pencil or a piece of carbon from a dry battery. If carbon is used, care should be taken in sharpening it to a fine point, since it is extremely brittle. After insulating the whole arrangement, the initials may be traced. The carbon makes deep, sharply-defined outlines. Graphite lines are shallow and rough.—H. WORTHMANN.

A Switch Operated by Pressure on a Footboard

THIS type of switch will be found useful in a wireless station, especially for a test buzzer. It is operated



The switch is fastened to the underside of a table or shelf

by pressing on the footboard.

A common S.P.S.T. switch has a bent spring of stiff brass fastened to the base and so adjusted as normally to keep the switch blade away from the jaw.

The switch is fastened to the underside of the table or shelf. A stout cord is tied to the handle and passed over a pulley, and the other end is fastened to a hinged piece of board, as shown in the drawing.—JOHN B. RAKOSKI.

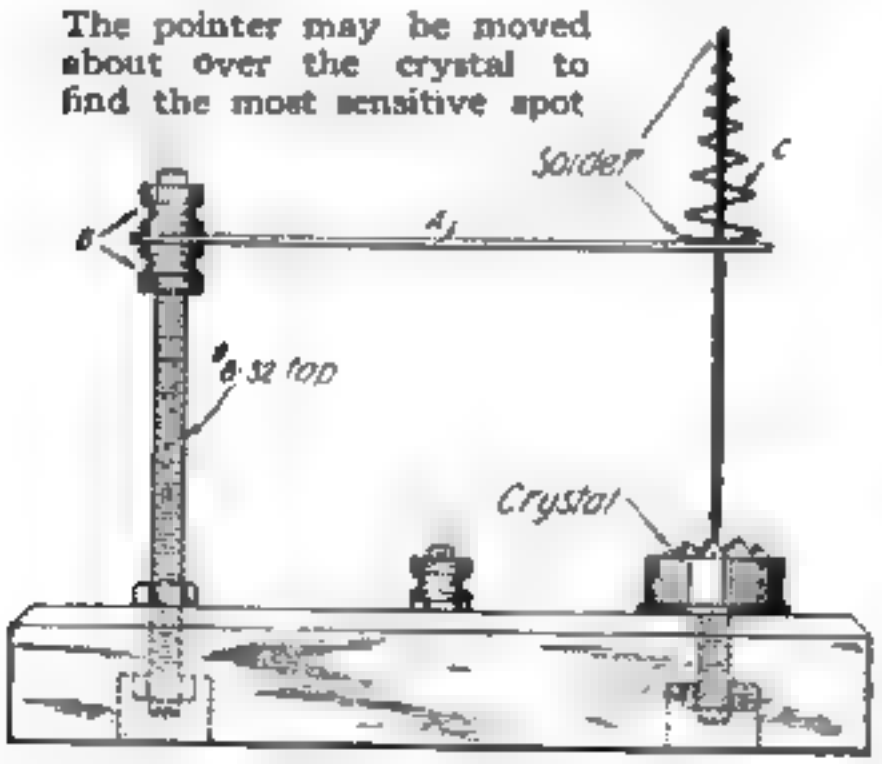
Differences in Time Between New York and Foreign Points

EXPERIMENTERS are sometimes confused by the difference in time used at various foreign points. France and England use time five hours ahead of New York, Germany's time is six hours ahead. San Francisco is three hours later than New York, and Honolulu time is 5½ hours slower than New York.

Making a Crystal Detector from Cheap Materials

THE base is a piece of oak about 2 by 3 in., having the top edge beveled to improve its appearance. A hole is drilled ½ in. from one end and in the center of block, to admit a short length of ⅛-in. threaded brass rod, to be held in place by two nuts taken from an old battery. Next a small piece of thin spring brass *A*, 2 in. long by 1/16 in. at one end and tapering to ¼ in. wide at the other is made. At the larger end a hole is drilled to allow this spring to be mounted on the upright brass rod by two thumb nuts, also taken from an old battery.

At the smaller end a hole is drilled, large enough to allow a piece of brass hatpin to slide freely through. Make a small tapered coil spring by winding fine springy wire on a match which has been whittled to a point and solder this spring at the smaller end to the piece of hatpin, which should be about 1½ in. long, so that the free end of the spring will be ¼ in. from the point of the hatpin. Now place the pin, point downward, in the hole in the smaller end of brass strip. Solder the larger end of the fine coil spring to the brass strip so that



The pointer may be moved about over the crystal to find the most sensitive spot

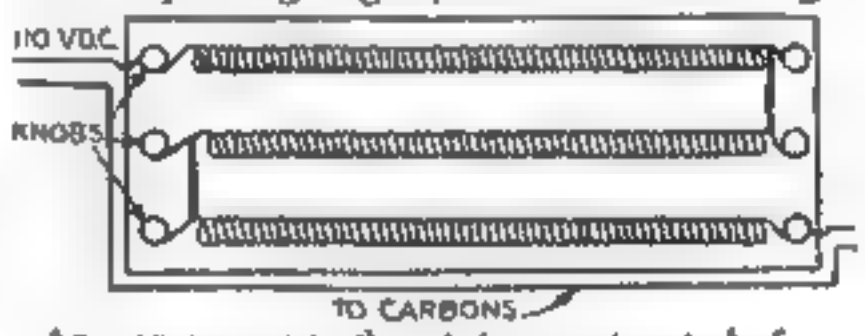
the hatpin floats freely within the hole.

Now you are ready to fasten your detector cup with crystal mounted in it, to the base so that the pointed end of the hatpin will make a light contact with the surface of the crystal. If the point of the pin does not touch the crystal its height should be adjusted by means of the thumb nuts *B*.

The fine coil spring *C* allows the contact point to be moved about over the crystal to locate the most sensitive spot, and also acts as a shock absorber to take up all ordinary vibration. The holder can be improved by mounting the crystal cup movably, according to any of the well-known methods.—RAY MAXWELL.

Saving the Picture Show with a New Rheostat

RECENTLY a new moving picture theatre found itself short a rheostat on its opening night, with no time to get



An emergency rheostat constructed for theatre use when one could not be obtained

one if the show was to start promptly. The man from the power-house was equal to the emergency, however, and made one, shown in the drawing, from the following materials:

One baseboard, 18 in. by 4 ft.; six porcelain knob insulators; six brass screws and three common coiled steel gate springs. These springs are 1½ in. by 16 in. coils. The baseboard is covered with heavy asbestos paper. The springs are connected in series with each other and the lamp carbon circuit. They are mounted with sufficient tension to open the spring far enough to prevent the coils from touching.

As shown in the drawing, they will pass about 30–35 amperes, without heating very much. This insures a nearly constant current, as there is not much change in resistance. More springs in series will cut down the current, and a reduction of the number will increase the amperage at the carbons.

Wireless Telegraph Stations in the West Indies

THE Cuban government has nine wireless telegraph stations in Cuba and on the Isle of Pines. There are two radio stations in Haiti. The respective governments have also equipped stations in Bermuda, Nassau, Curacao, Bonaire, Trinidad and Tobago.

A Combination Front and Back Door Alarm-Bell

FASTEN a common alarm clock on a block of wood, after removing the bell and legs. The block must be cut out to expose the back of the clock so

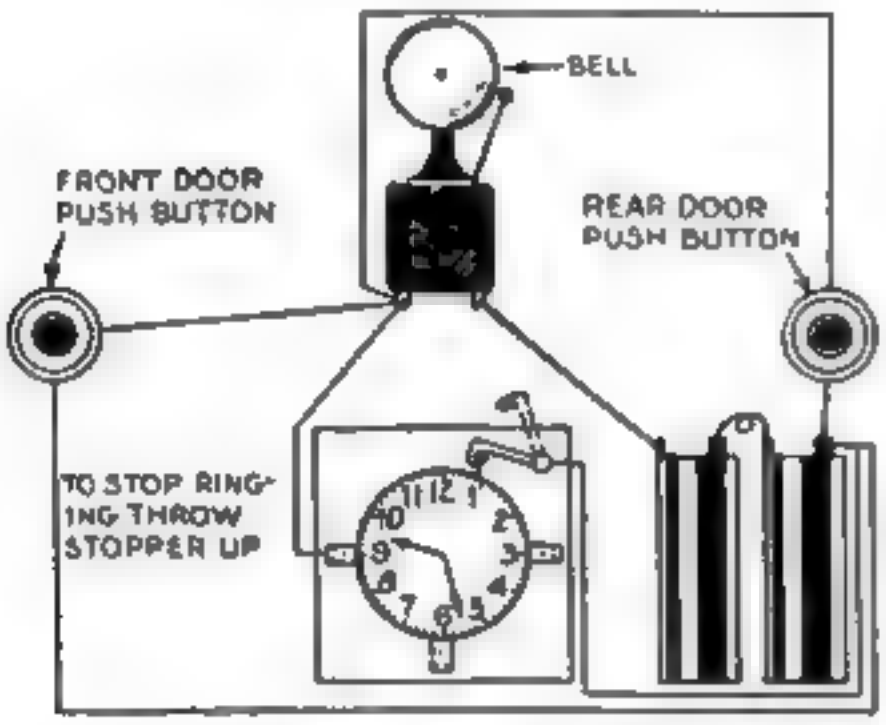


Diagram of the wires for alarm in connection with the front and back door bells

it can be wound. Two strips, about 4 in. wide, hold the block from the wall for this purpose. Three light angle strips hold the clock to the board. In the upper corner of the board place the contact hook, loosely pivoted and supported by a small brad driven into the board.

When the alarm is released the hammer makes contact with the hook, closing the bell circuit. This bell will ring until the hook is thrown back. The connection to the door-bells are ordinary. Partially run-down batteries from an automobile may be used for this arrangement, connecting a sufficient number in series to ring through the bell circuit.

Insulating and Decorative Enamel for Electro-Magnets

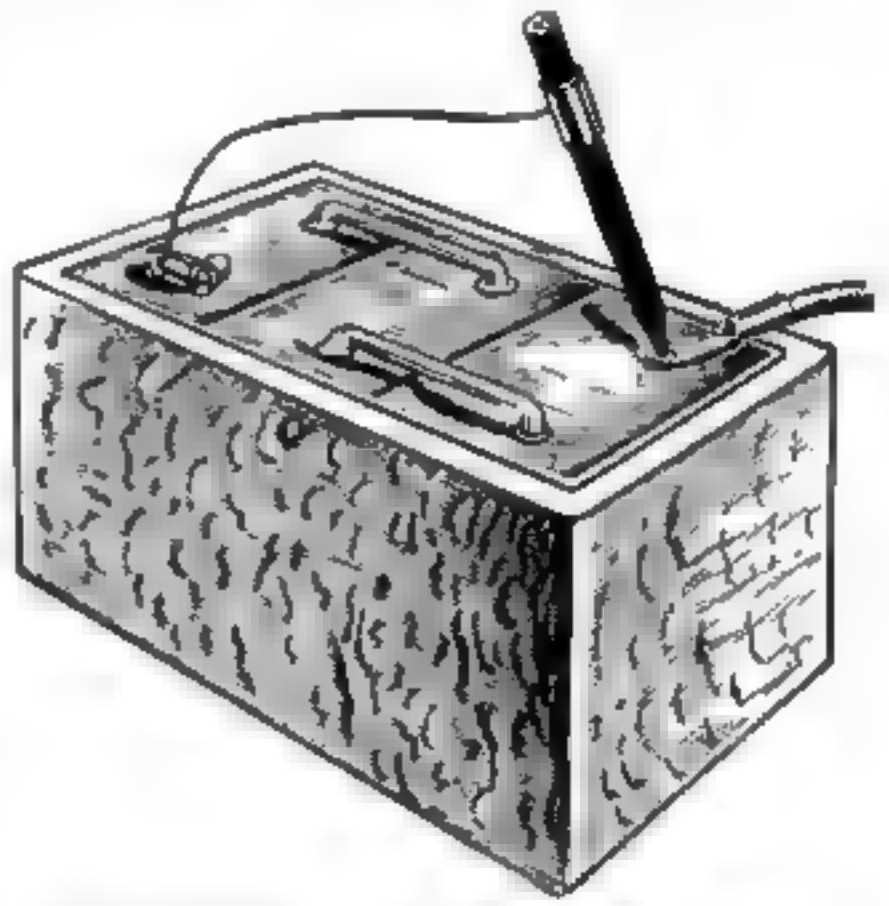
IN half an ounce of wood alcohol dissolve one small stick of colored sealing wax; shake thoroughly at regular intervals to facilitate complete dissolution; put mixture in a tightly corked test tube or small vial. This mixture will keep indefinitely, and may be applied with a small camel's hair brush. Shake tube well before using. This is a quick drying and lustrous enamel.

Electric Burner for Making Storage-Battery Connections

IT is well to have all connections on storage batteries fastened to the binding posts in a permanent way by soldering or lead burning. To do this work properly requires an oxygen burner, but the layman is not always sufficiently familiar with the use of this gas to make the proper application, and the apparatus is a rather expensive one to keep on hand.

The current taken from the cell is sufficient for the heat element and it is only necessary to make connections as shown in the illustration. Almost any partially experienced person can fasten the connecter by lead burning.

To produce the proper amount of heat, an old carbon taken from an arc lamp is filed down to a small point to reduce the cross section area and is used the same as a soldering iron. The carbon is fastened to one terminal binding post of the battery with a large wire, using a piece of sheet brass around the carbon to make a better connection. Clean the binding post thoroughly to make a good weld. The carbon held on the binding post as shown quickly heats it to a point that will melt the lead; then the carbon is used in the same way



The current taken from the cell is sufficient to weld the connections to the binding-posts

as an ordinary soldering iron in making a good union of the parts.

To Change a Gas Lamp into an Electric Light

TO change from gas to electric light on motorcycle headlights and retain the convenience of both, all that is necessary is to solder a candelabrum socket to the old burner. Care should be taken to have the burner just the right height so that the lamp can be focussed properly.—F. G. DALY.

Best Wavelengths for Certain Distances

IT has been figured out that for sending 700 kilometers the best wavelength is only 275 meters, in so far as the conditions between the two stations are concerned. For 1000 kilometers, the best wave is about 560 meters long, and for 1500 kilometers about 1250 meters. This computed result may be greatly modified by the characteristics of the sending and receiving antennas, however.

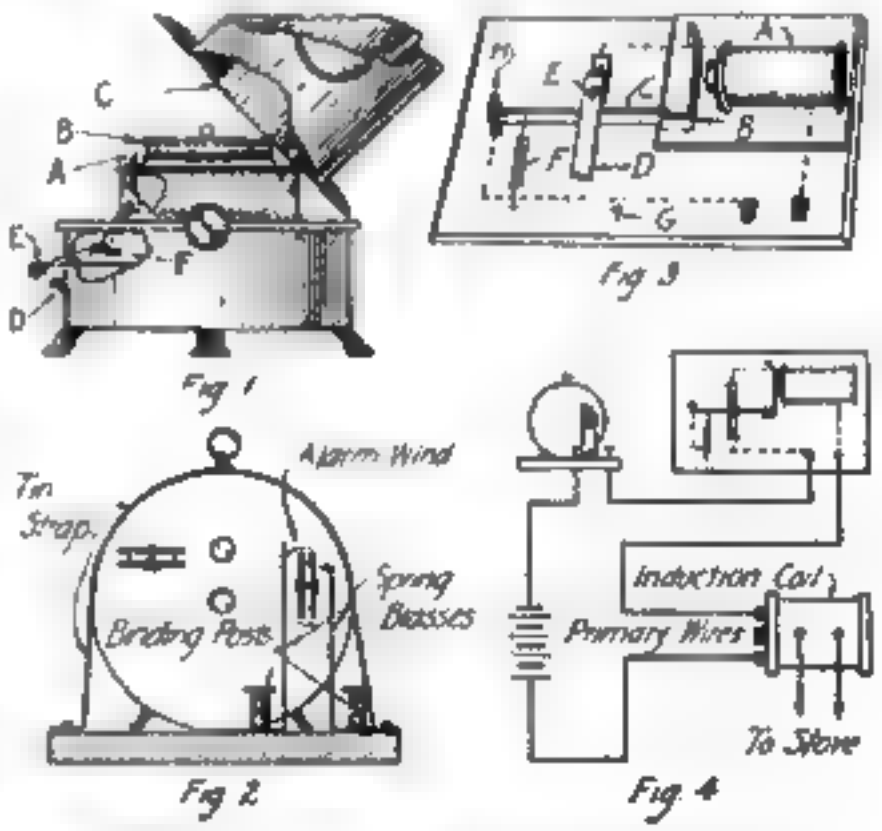
Lighting an Oil-Stove with an Alarm-Clock on Cold Mornings

NO one really enjoys getting out of bed on a cold morning before the room is heated. And it is not really necessary; for with an oil-stove, an alarm-clock, a spark-coil (a ¼-in. coil is sufficient), an old bell, some spring-brass, binding-posts and wire, an arrangement can be made to obviate it.

The oil-stove, with the hood turned back to expose the burner, is shown in Fig. 1. The wire may be ordinary 14-gage, asbestos-covered. The principal thing to be observed is that the distance from the wire *A* to the burner *B* is less than from the wire to the flue *C* (which comes down and covers the burner); otherwise the spark would jump from *A* to *C*, instead of through the wick to *B*. This distance is best determined by experiment. Over the wire *A* is a tin strip *F*, soldered to the tank to hold the wire in position. The connector *E* may be removed by loosening the connecting screws; this permits taking out the tank without disturbing the spark-wire. Grounded to the frame of the stove is a binding post *D*.

The alarm-clock is mounted on a small board, as shown in Fig. 2. Have the brass springs sufficiently heavy and far enough apart to permit the key, when turning, to be held by the bend at the top of the spring. The important part of the mechanism is the relay, which turns off the current when the stove is lighted. A buzzer or an old door-bell is shown at *A*, Fig. 3, with the hook *B* soldered on to the end of the armature. A piece of sheet metal *C* is bent snugly around the screw *H*, which has a shoulder filed in it to prevent *C* from lying on the board. A piece of brass, *D*, is bent as shown, with a hole drilled for the screw *E*, which adjusts the tension of *D* on *C*. The spring *F* tends to pull *C* to the stop *G* out from under the spring *D*. The wiring is shown by dotted lines.

The action is as follows: The magnet *A* draws the armature *B* to its core. This releases the spring *C*, which slides slowly (its movement is regulated by the screw *E*) out from under spring *F*, causing a sliding contact of a few seconds' duration, which ends in disconnecting the primary circuit. Dampening the movement of the spring gives the spark time enough to to ignite the cold oil.—ARTHUR F. STILSON.



Wiring diagram and connections (Fig. 4) to an alarm-clock for lighting an oil-stove

What Radio Readers Want to Know

Calculating Wavelengths; Circuits of Audion Amplifier; Helix for Spark-Coil

E. B., Pittsburg, Pa., inquires·

Q. 1. I have a loading coil for an inductively coupled receiving tuner consisting of 625 turns of No. 22 enameled wire wound upon a tube 5½ in. in diameter, also a secondary loading coil wound with No. 27 enameled wire for a distance of 7 in. on a similar size tube. Approximately what is the wavelength of each?

A. 1. We cannot give the possible wavelength adjustment of a coil without knowing the constants of the circuit in which it is to be employed. It is easy to calculate the natural wavelength, but this data would be of no value for ordinary usage. The primary loader has inductance of approximately 12,400,000 centimeters and the other coil about 15,875,000 centimeters (15,875 microhenries). You of course understand that the increase in wavelength to be obtained with a given loading coil depends upon the natural inductance and capacity of the circuit in which it is to be connected; consequently, if these values are unknown, no general estimate can be given. You will then see that there is no such thing as a "2800 meter loading coil" even though manufacturers are prone to use the notation.

Q. 2. My Navy type receiving tuner has a primary winding consisting of a single layer of No. 20 enameled wire wound upon a tube 4½ in. in diameter for a distance of 5 in. The secondary tube is 3½ in. in diameter, wound for a distance of 5 in. with No. 30 enameled wire. What is the maximum wavelength this tuner will respond to?

A. 2. Lacking the dimensions of the aerial it is difficult to advise; but with one of the usual amateur dimensions, the primary circuit is adjustable to waves of 4500 meters. With a capacity of .0001 microfarads in shunt, the secondary circuit will respond to 2400 meters but with .001 microfarads in shunt the wavelength of the circuit is about 7000 meters.

Q. 3. I require two loading inductances for this set to be adjustable to 14,500 meters in steps of 500 meters at a time; but they cannot occupy a space more than 8 in. by 5 in. by 3 in. Can you supply the data for the windings?

A. 3. We know of no method by which you can obtain this value of wavelength with a coil of these dimensions unless you wound it with very fine wire which, of course, would make them useless. Also keep before you the fact that there are no stations in operation that use the wavelength of 14,500 meters. Why not construct a set like that described by McKnight in the April, 1916, POPULAR SCIENCE MONTHLY?

Q. 4. Can you furnish me with the circuits of the single step Audion amplifier?

A. 4. See the accompanying diagram.

Q. 5. What is the voltage of the filament battery?

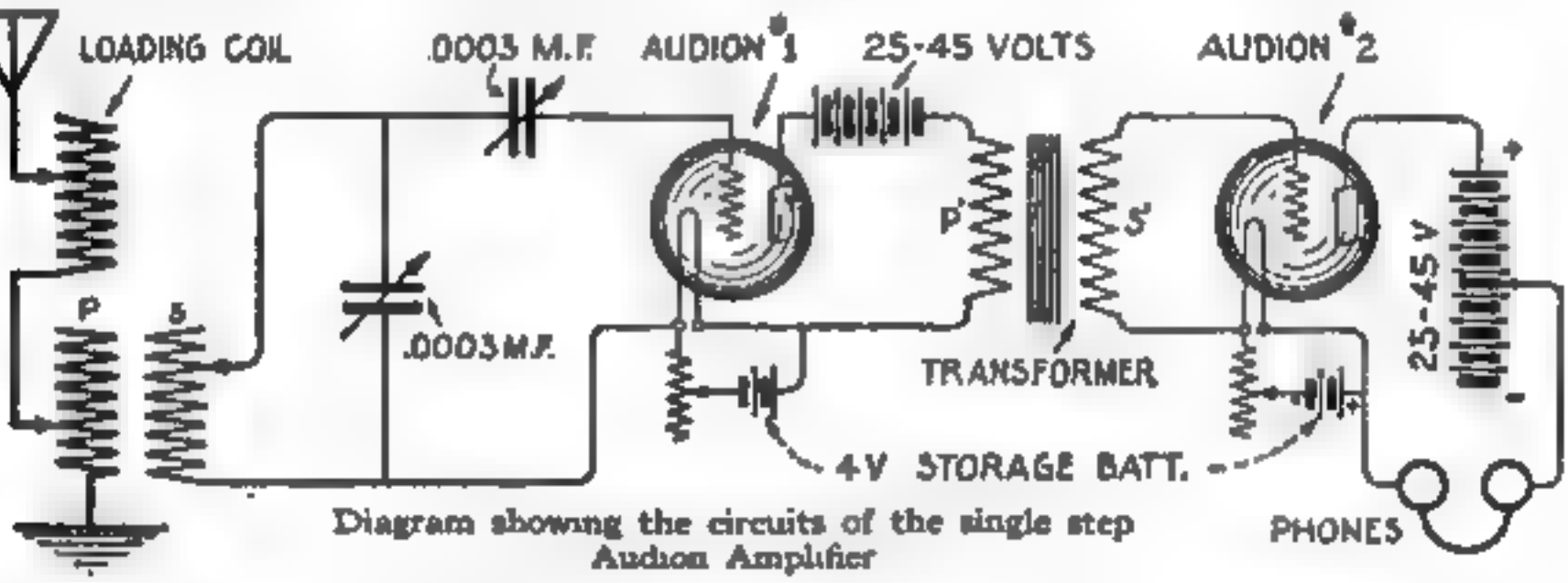


Diagram showing the circuits of the single step Audion Amplifier

A. 5. 4 volts.

Q. 6. What is the voltage of the second battery?

A. 6. 25 to 45 volts.

Q. 7. Is the Audion tube suitable for this?

A. 7. Yes.

Q. 8. Can you give me the voltage of the telephone battery in the RJ5 Audion?

A. 8. 25 to 45 volts.

Q. 9. What type of battery cell is used?

A. 9. A 20-ampere hour storage cell for the filament and 10 tungsten flashlight cells for the telephone battery.

Q. 10. How many turns of edgewise wound copper ribbon 7½ in. inside diameter, 8½ in. outside diameter, 1–16 in. in thickness, are required as a helix for a 3-in. spark coil?

A. 10. The helix requires 10 turns of the copper spaced ¼ in. apart. A condenser of .002 microfarads is sufficient. A single plate of glass 14 in. by 14 in. covered with thin foil 12 in. by 12 in., the glass being ¼ in. in thickness will give the required value of capacity.

Umbrella Antenna; Variometer; Loose Coupled Tuner

E. C. S., Deer Lodge, Montana, writes:

Q. 1. Please state the dimensions for an umbrella aerial to have a natural wavelength of 165 meters. The pole for support of same is to be 55 ft. in height and the antenna proper is to consist of from 12 to 20 wires. The lead-in wire will not be over 15 ft. in length.

A. 1. We know of no formula by which the natural wavelength of an umbrella aerial can be computed exactly but as an approximation we should say that if the ribs of the umbrella are extended to a distance of 20 to 30 ft. from the top of the mast, the natural wavelength will be about the value you require.

Q. 2. Can a rotary variometer be made to tune from 200 to 1500 meters? If so, please state the correct dimensions.

A. 2. We are not quite sure as to the type of apparatus you refer to. Some misunderstanding seems to exist among amateur experimenters regarding the action and the use of a variometer. Ordinarily the term variometer is applied to a variable inductance the value of which may be varied from nearly zero to maximum by means of two concentric inductance coils of fixed value which are connected in series. The inner coil usually rotates on an axis and is constructed so that it can be turned completely around. In one position the magnetic fluxes of the two coils are opposite with an approximately zero value of inductance. In the other position the magnetic fields of the two coils are accumulative and the inductance value is at a maximum. The variometer for amateur purposes may have the following dimensions: The outer coil may be a cardboard tube 6 in. in diameter wound with a single layer of No. 24 S.S.C. wire to a width of 2 in. The inner coil is 5 in. in diameter wound to about 2¾ in. with No. 26 S.S.C. wire. The inner and the outer coils are of course connected in series.

Q. 3. In the case of a receiving apparatus where a distant transmitting station can be tuned to by means of inductance alone, will the use of a variable condenser intensify or assist in any manner in securing a higher degree of sensibility?

A. 3. In an instance where the audion is employed as a receiving detector and the inductance is of such value as to permit the receiving apparatus to be tuned to the distant transmitting station, a variable condenser is of little use, but where the secondary winding of a receiving tuner is fitted with a multipoint switch, the variable condenser gives a closeness of adjustment between the taps of the switch which cannot otherwise be obtained. The variable condenser in shunt to the secondary winding of a receiving tuner is only of value under conditions of loose coupling between the primary and secondary circuits.

Q. 4. From the standpoint of long range and efficiency, which is the better, an inductively receiving tuner or an ordinary straight-coupled tuning coil?

A. 4. Practically equal degrees of signal loudness can be obtained with either type, but the inductively coupled tuner is preferred on account of the ease with which the mutual inductance between the primary and secondary windings can be regulated and the sharper tuning which results. Similar effects of course can be obtained in a simple tuning coil by the use of three sliding contacts, but the operation is more complicated.

Photographs of Marconi Apparatus and Books on Radio Topics

H. P. B., Chicago, Ill., inquires:

Q. 1. Where may photographs be obtained of Marconi apparatus either on board ship or inland stations?

A. 1. Application for such photographs may be made to Mr. George W. Hayes, superintendent of the factory, the Marconi Wireless Telegraph Company of America, Aldene, N. J., Underwood & Underwood, New York City, also have in stock photographs of wireless telegraph equipment.

Q. 2. Are there any books on the market which cover the quenched spark system of radio telegraphy in detail?

A. 2. No; there is no publication that covers distinctly the quenched spark system in detail, but practically all modern books of wireless telegraphy cover the subject partially. Perhaps Zenneck's "Wireless Telegraphy" gives about as complete a description of the action of the quenched spark discharger as can be obtained.

Q. 3. Kindly tell me in what publication the following subjects are treated in a simple manner and in a way that may be understood by the beginner, viz.: Damping; Logarithmic Decrement; Inductance.

A. 3. No simpler description of the Logarithmic Decrement and the effects of Damping can be obtained than that given in the May, 1916, issue of the POPULAR SCIENCE MONTHLY.

Copper-clad Antenna Wire and Thickness of Copper

P. L. D., Grants Pass, Ore., inquires:

Q. 1. Is copper clad wire with a core of iron wire suitable for wireless telegraph purposes?

A. 1. Yes; it has been used on commercial installations for a number of years.

Q. 2. How thick should be the copper coating?

A. 2. A coating of 1–64th of an inch is quite sufficient.

A Simple Electrical Device for Purifying Water

A DEVICE for purifying water by means of electricity can be made at very little cost by the use of a few elements which are easily obtainable. It may be done by procuring an aluminum tube *A*, 4⅓ ins. long, and 1½ ins. in diameter. It is immaterial about the gage. Also purchase an aluminum rod *B* the same length, of ⅜-in. material. A piece of hard rubber, or fiber, *C*, ⅝ in. thick, and 1½ ins. each way. This is to be turned in a lathe so it will fit into one end of the aluminum tube.

The rubber cork thus provided has a central hole to receive the ⅜ aluminum rod, as shown. One of the set-screws *D*, for holding the head *C* and tube *A* together, serves as a means for connecting with one of the terminals *E*, while a screw *F* in the upper end of the rod *B* acts as a binding-post for the other terminal *G*.

The tube *B* should have a few notches, as at *H*, at its lower end. An inch from the upper end are two or more holes *I*, the object being to provide a means for circulating the water when the current is doing the work.

This manner of treating water is known as the direct electrical method; whereas ozonization is the indirect means. Both systems, however, depend on the generation and application of ozone, or nascent oxygen, which attacks the organic matter in water. The result is that such substances are coagulated and precipitated, thus leaving the water pure and wholesome. This system is in every respect superior to filtration. The latter method clarifies, but does not purify.

The article thus constructed is admirably adapted to stand in a glass of water, as shown, for a minute or two, and then be taken out. The action of the current in passing through the water between the electrodes *A*, *B*, causes a milky appearance, which gradually changes. The solid matter first gathers at the surface of the water, and after giving off the gases contained in the globules, falls to the bottom, leaving a clear liquid.

A wonderful test of the efficiency of this method of purifying may be made by adding a few drops of ink to the water before putting in the device. It will be found that the precipitate will contain all the ink, and that the water will be as clear as before.

The water moves up along the space between the two electrodes and down outside the tube

The water moves up along the space between the two electrodes, passes out through the holes *I* and down outside of the tube *B*. By means of the circulation thus set up every part of the water is treated and the oxygen bubbles pass through the water, thus attacking the organic matter and eliminating it entirely.

The duplex wires *E*, *G*, should have an electric plug at the other end which may be applied to the ordinary socket. The dimensions given will be correct for a 220-volt circuit. In case of a 110-volt circuit the tube *A* should be 1¼ ins. in diameter, or the rod *B* should be larger, say, ½ in. or ⅝ in. in diameter to give the most efficient service.

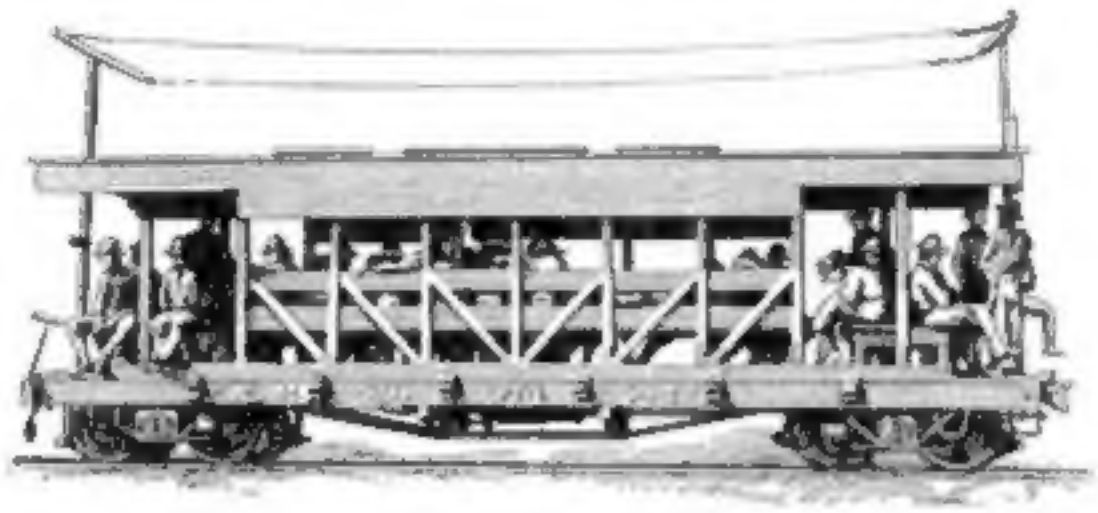
There is some difference in the resistance of various waters, which is not sufficient to require a change in the specifications, but in such cases the experimenter will soon learn the correct time required to treat a certain quantity of water, and not allow the device to remain in action too long.

The device will act equally well by plunging it into a pitcher of water, if left there long enough to thoroughly ozonize the whole.

Converting a Freight Car Into a Wireless Station

WHEN the United States troops went into Mexico, they were forced to meet a number of unusual conditions. In Vera Cruz, for example, they found new and difficult situations and their ingenuity in overcoming some of these handicaps is interesting.

A train was run twice daily under a flag of truce from Vera Cruz to the interior. This was always accompanied by a small guard. Inasmuch as a treacherous attack upon the cars was likely to occur at any time, it was considered desirable to keep in communication with the train. Since this could not be accomplished in any other way than by wireless, a complete installation was made in one of the passenger coaches. An upright was erected at each end of the car, and aerial wires were strung between cross-arms mounted upon these. The instruments themselves were placed upon the cushioned seats within the car, thus avoiding difficulty from vibration. The ground connection was made through the trucks of the car, and power for the transmitter was supplied by a small hand-power generator. A fixed radio station was also installed at headquarters in Vera Cruz, and messages were exchanged between this plant and that on the train, even when the latter was in motion.



The exterior view of the car with aerial on top

When the Army landed, the Navy men were relieved of guarding the city and train, and the Signal Corps took over the wireless work. A small gasoline-driven motor-generator was placed on the train, and the satisfactory work was continued until the main railway line was reopened and through trains began running between Vera Cruz and Mexico City, some months later.

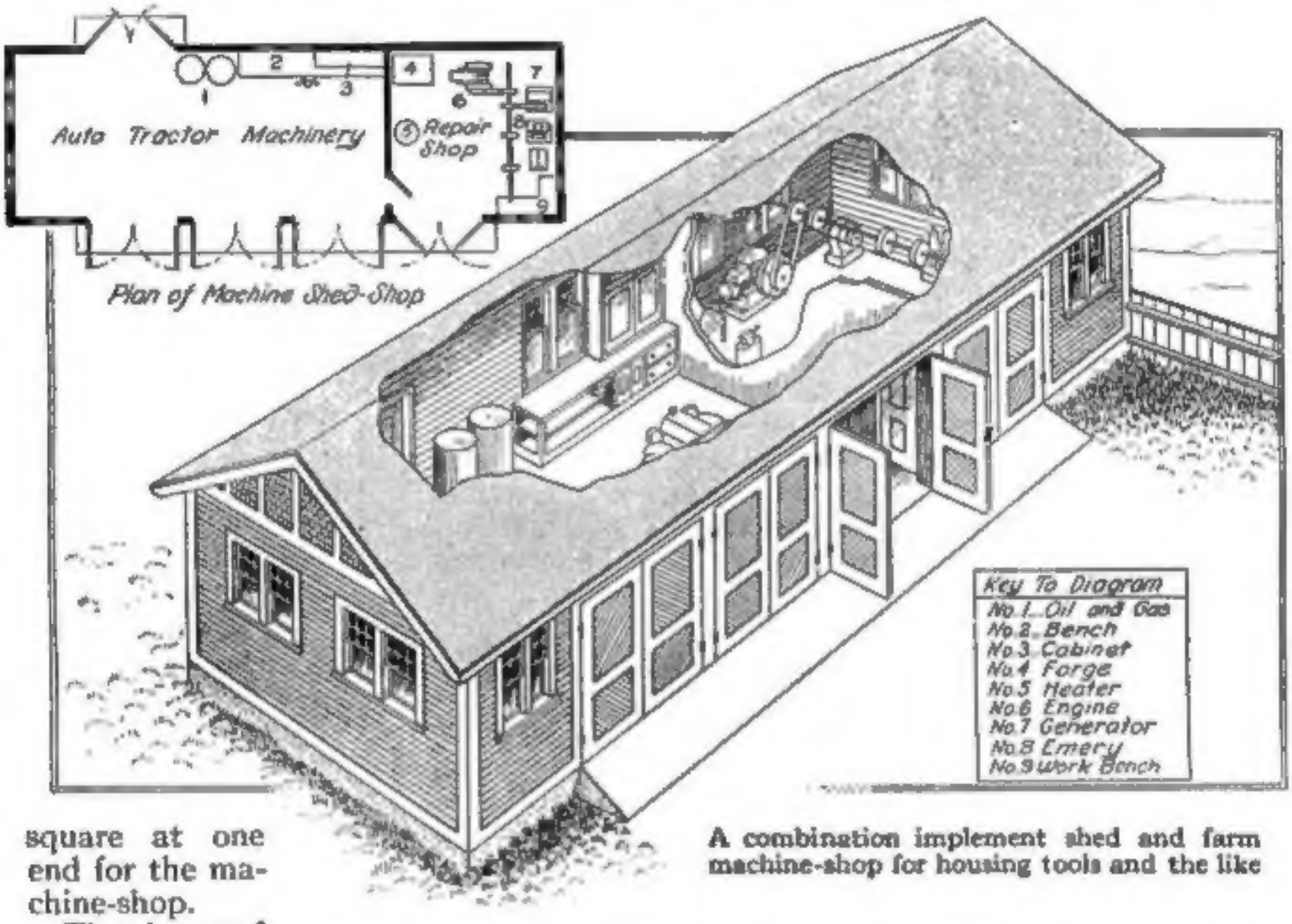
A new Headquarters station was erected on the roof of the Terminal Railway Station, having a four-wire umbrella antenna supported from a 40-ft. pole, and maintained constant communication with all the neighboring plants as well as with the ships in the harbor. By use of the network of wireless and buzzer-systems it was possible for Headquarters to learn instantly of conditions at all the outposts.

A narrow gage railway line connected Vera Cruz with the detached post at El Tejar, about nine miles south, and the train wireless equipment was transferred to cars run over this division. No passenger coaches were available, so a framework with a flat-top aerial above it was built upon one of the springless flat-cars. When the train was still this worked well, but with the cars in motion there was so much vibration that a springboard was arranged to support the apparatus.

Interior view showing the apparatus in working order

A Combined Farm Implement Shed and Machine-Shop

THE accompanying drawings show a plan for a farm implement storeroom and machine repair-shop. The construction is very simple, being a rectangular building with an ordinary plain gable roof of one-third pitch, all being set on a concrete foundation. The size of the entire building is 72 ft. long by 24 ft. wide, with a 9-ft. studding. This size is sufficient to house an automobile, a tractor and much of the farm machinery, leaving a space 24 ft. square at one end for the machine-shop.



A combination implement shed and farm machine-shop for housing tools and the like

The shop end of the building is essential; for the intricate machinery of the farm equipment to-day requires better facilities for mending and keeping in order than just a forge and an anvil.

The shop part is large enough to accommodate a gasoline engine, about horsepower, for driving a line-shaft, where power may be used to drive a drill press, lathe or emery wheel, or to house a farm lighting-plant. If a good partition is provided this part of the building can be heated with a small stove at practically no cost.

Such a building can be made attractive and substantial if properly located. The cost is not prohibitive. The materials required for the concrete work are 32 barrels of cement, 15 yards of sand and 24 yards of gravel. The framework will require 2,800 ft. of 2-in. dimension lumber, 2,300 ft. of siding, 2,400 feet of lumber and 21,000 cedar shingles.

If the plot is not level excavate the ground the size of the building and thoroughly tamp it down, or place in cinders and tamp them well before beginning to put in the concrete mixture. Forms of rough boards may be held in place with stakes on the outside line of the building and the concrete put in the same as for building a sidewalk, making the surface of a neater mixture and troweling it down smooth. The building is raised on this in the usual manner.

The approach to the doorways is also made of concrete and should be a part of the floor. The forms can be built up at the ends sloping so that the surface can be struck off with a straightedge. This is the most economical method.

To Our Supporters

When Edward Livingston Youmans founded the *Popular Science Monthly* in 1872, he had a very clear purpose in mind. "Science is not the mystery of a class," he put it, "but the common interest of rational human beings." And so he would tell a contributor: "Keep in your mind's eye a person of common intelligence and quite unacquainted with the subject you are seeking to explain."

When I assumed the editorship of the *Popular Science Monthly* a year ago, I made up my mind that we must never lose sight of Youman's ideal. The opportunity was rich. Wireless telegraphy, aeroplanes, automobiles, radium, X-Rays, all were unknown in his day. In a single year more scientific discoveries and important inventions are now made than in a whole decade forty years ago. And then, the technique of printing and illustrating has developed marvelously. There was no half-tone process when the *Popular Science Monthly* was founded, no rapid and effective way of driving home a point by picture.

With this wealth of modern material and with wonderful modern facilities, the *Popular Science Monthly* entered upon a new phase of its career a year ago. In that brief space of time its circulation has more than doubled. Over two hundred thousand copies are now printed. And the circulation is growing by leaps and bounds.

I wish to thank the many thousands of supporters who have made this success possible and, above all, the hundreds of contributors who have helped me to present the facts of current science, engineering and invention interestingly and truthfully.

Waldemar Kaempffert

The football coach, gripping the lever-handle firmly swings the dummy away from the tackler as he rushes at it. The effect is that of an active, dodging, living opponent